FILE COPY

MTM

The Journal of Methods-Time Measurement

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

November-
December

1957

Vol. IV
No. 5

In This Issue ...

Improving Job Shop Operations

Developing Standard Data for Clerical Operations

MTM's Contribution to Establishing and Balancing Assembly Lines

MTM

The Journal of Methods-Time Measurement

November-December 1957

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

MTM

The Journal of Methods-Time Measurement

November-December 1957

MTM Association

Editor..... Richard F. Stoll

The Journal is published five times annually during the months of February, April, June, August, and December.

Subscriptions Available Through
MTM Association, 216 S. State Street
Ann Arbor, Michigan

Subscription: $2.50 per year in U.S. and Possessions and Canada. Single copy, 60 cents.
Elsewhere $3.50 per year.
Single copy, 75 cents.

Volume rate for 25 or more copies of any one issue - $ .50 per copy.

Controlled circulation permit
Ann Arbor, Michigan

MTM Association Officers: 1957

President—Benjamin Borchardt, Benjamin Borchardt & Associates, Los Angeles, California

Vice Presidents—Malcolm Gotterer, Harvard University, Boston, Mass. D. W. Karger, The Magnavox Company, Fort Wayne, Ind. G. C. Moore, Westinghouse Corporation, Pittsburgh, Pa. Robert Rick, A. T. Kearney & Company, Chicago, Ill. Richard Robertson, Norma-Hoffmann Bearings Corp., Stamford, Conn.

Secretary—James McGovern, American Box Board Co., Wausau, Wisconsin.

Treasurer—Richard Berkeley, Ernst & Ernst, Detroit, Michigan.

Executive Secretary—Richard F. Stoll, MTM Association, Ann Arbor, Michigan.

CONTENTS

November - December

Applications

I - Improving Job Shop Operations 3
John Divine and Jack Ringham

II - Use of MTM in Establishing Data and Standards for Light Machining Operations. 11
Wallace E. Witt

III - Developing Standard Data for Clerical Operations 21
J. L. Morrissey

IV - The Use of MTM in Methods Development 30
Lucille Gill

V - Standard Data in the Sewing Room . .33
E. J. Smith

VI - MTM's Contribution to Establishing and Balancing Assembly Lines 45
J. F. Radford

MTM News 57

Editor's Note:

The Association has tried in every way possible to check the veracity of material published in the Journal of Methods Time Measurement. However, the opinions of the authors are not necessarily the opinions of the Association. The Association, therefore, will not be held responsible for any liability which may develop from any material in this publication.

Speeches in this Journal were presented at the A. T. Kearney and Company Seminar, October 30, 1957 in Chicago, Illinois

IMPROVING JOB SHOP OPERATIONS

by
John Divine and Jack Ringham
Danly Machine Specialties, Inc.

INTRODUCTION TO DOWEL PIN PACKING

It is a distinct pleasure for us to have this opportunity to present to you, who are attending this seminar, a discussion about the techniques we employed in our effort to improve job shop operations.

We are engaged in the endless task of improving our job shop operations.

One of those which we have selected for our discussion is a task consisting of the making of a box, and subsequently placing the correct number of dowel pins into the box, and sealing it with a label. We have titled it "Dowel Pin Packing".

You engineers are aware of the fact that operations such as this one, which are primarily manually controlled, genuinely deserve extensive methods analysis. If we are not extensive in our analysis work, we may not be entirely successful with our improvement installations.

As will be described to you in detail, we were forced to analyze the methods surrounding our Dowel Pin Packing operation twice within the past three years. Stop watch time study was used for obtaining the information for standard time data in the first instance and MTM was used in the second.

If we had not been thorough in our analysis of method and in the determination of time standards in either of the two situations, I am quite sure that we would be packing dowel pins today with the same four girls who were doing the work three years ago, instead of only one girl, who is packing an equal volume of pins.

The historical facts surrounding this operation tend to prove my assumption.

When standard time data had been completed for "Dowel Pin Packing" in early 1955, a complete change in workplace layout, and a modification of the type of box and label had been accomplished.

Using the new standard time values, it was determined that a work load existed which would require the services of about two girls. Therefore, two of the four girls who were performing the task were transferred to other jobs. But, that which was obviously true did not materialize.

Within a very short period, the area where dowel pins were stored prior to their being packed became alarmingly congested. Shipments of dowel pins were depressed. The faith in our standards program at Danly was weakened. It was common knowledge among all of our supervisory personnel that the two girls packing dowel pins were only able to achieve a performance level of forty per cent of standard.

During this time, we were having supervision meetings which were being conducted for the purpose of aiding the supervision in their personnel problems. The subject of at least one of these meetings was how to handle the personnel problem involved in dowel pin packing, or more pointedly, how to handle the standards department so that they would gracefully inflate their standards.

Needless to say, the analysis which was made in the determination of the time standards was subjected to severe critical scrutiny by our management.

Only after they were completely satisfied that the standard time data was entirely factual were measures taken to correct the situation. Personnel were changed, supervisory attention was increased, and gradually performance rose to one hundred and twenty per cent although the standards were unchanged.

The extensiveness of our analysis work had been justified. The backlog of unpacked pins was gradually depleted and shipments were back on schedule.

When it became necessary to revise the standard data again at the end of 1955, you can appreciate how grateful we were in being fortified with the tools of Methods Time Measurement.

APPLICATION I

In order to explain the detailed study of part of the operation, I would like to present our industrial engineer who is in charge of the development and maintenance of standards at Danly, Mr. Jack Ringham.

The task of getting dowel pins packed into boxes is actually done in three distinct operations:

Boxmaking, Packing, and Labelling

We will discuss primarily the packing, although MTM was actually used effectively in methods and standards work done on all three.

In the packing operation, there are the following variable factors:

1. Pin size varies from 1/8" diameter by 3/8" long to 7/8" diameter by 4" long. There are about 90 different sizes of pins in this range.

2. There are seven difference box sizes.

3. The number of pins per box can be 10, 20, 50 or 100.

Each stage of improvement of the operation involved a basic method. In each of these methods there were fundamental motion patterns which were the same in all situations although distances moved and the number of times each motion was performed varied with the factors mentioned.

In the original method employed when four girls were required on the operation, it was thought necessary to have the pins inspected for length, since occasionally an incorrect length might slip through. The pins were lined up side by side with their ends against a straight edge so that their lengths could be compared. Several rows of pins would be lined up in this manner and the incorrect pins removed. The remaining pins were then counted and swept into a box. Time for a typical part was .51 minutes to pack 20 pins in a box.

Since lining pins up and inspecting for length took a majority of the time for this element, we attempted to eliminate this portion of the element. We found that, with proper attention, most of the incorrect lengths could be sorted out in previous operations at no additional cost. The few remaining incorrect lengths could be spotted by the packer and removed.

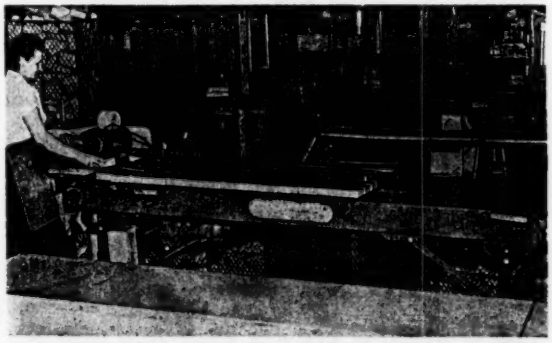
The practice of lining pins up against the straight edge was eliminated. Instead, the packer reached to the pile of pins, counted out a definite number of pins - usually 3, 4 or 5 depending on size - and pulled that number into the box. In packing a box of 20 pins, the packer might count out and pack 5 groups of 4 pins each. Time studies showed that the time for packing 20 typical pins was .15 minutes or less than one third of the time of the former method. This methods change, plus several others in the boxmaking and labelling, enabled us to reduce the personnel required on the operation from four girls to two and created the problems discussed previously. Let's look at some pictures of the workplaces as they appeared after the personnel were reduced from four to two girls. The operation was performed on two shifts with one girl on each shift.

In the boxmaking operation, cardboard flats are folded 3 to 6 at a time, and piled next to a staking machine. In staking the corners of a box top or bottom the flat is positioned on the anvil of the machine, staked, rotated 90° staked again and the process continued until the four corners are staked after which the box top or bottom is tossed into a basket. The staking machine operates at about one stroke per second with four strokes being required per box half. The girl doesn't even miss a stroke of the machine when asiding one and loading another box half.

In the packing operation the girl obtains a box bottom with her left hand, counts and packs the required number of pins into the box and places the box on the conveyor. After about two rows are filled, the conveyor is moved forward a short distance.

When the required number of boxes have been packed or when the conveyor becomes fully loaded, the girl moves to the labelling station at the other end of the conveyor. She obtains a box top from the basket on her left, covers the bottom containing the pins and seals the box

with a label dispensed from the labelling machine. The box of packed pins is then placed into a larger wooden container on the left.



Incidentally these pictures were taken recently, but the workplace was quite similar to this when the practice of inspecting pins for length was eliminated.

After this method had been in effect for about a year, other changes were made in the operation which made it necessary to revise our standards. This time we had a man in the department who was trained in MTM, and he was assigned the task of revising standards to reflect methods changes made, and also to make whatever additional methods changes seemed worthwhile.

An MTM analysis of packing our box of 20 typical pins showed that 324 TMU were required. This was equivalent to .156 minutes or quite close to the .15 minutes determined from time study.

The detailed MTM analysis permitted a much closer look at the elements of counting and packing pins into the box. It became apparent that there were definite finger motions associated with selecting the proper number of pins. These distinct motions were never obvious to the time study observer. The MTM analysis showed that when packing pins in groups of four the operator first performed a class B, reach to any pin in the pile. After grasping the first pin and moving it about an inch, a class C reach was made to a specific pin nearby and it was moved into position next to the first pin. The remaining two pins would be obtained in the same manner with class C reaches, and all four would be swept into the box. These short reaches all occurred so fast that it was hard to detect them visually.

We thought that it might be faster to reach for an approximate number of pins (about 3 or 4) using a class B reach each time and sweep them into the box, except for the final reach in which specific number of pins would be selected to obtain the desired total. As you know, a class C reach involves search and select whereas a class B reach does not. Our objective was to substitute one class B reach for a class B reach plus several short class C reaches. The only time class C reaches would be necessary was when obtaining the final group of pins to complete the desired box total. With this new method the packer was required to mentally keep a running total of the number of pins packed into each box so that the proper number could be obtained on the last reach. This method required only 192 TMU to pack our typical box - A 40% saving on this element.

It took several hours of working with the packer to determine that it was possible to use this method although it took much longer to train the girl to do it in the proper time.

This same type of approach was used on most of the other elements in the boxmaking, packing and labelling operations. Although we expected the physical improvements in the operations to

result in savings of about 20%, we found that using MTM as a tool in analyzing all operations we were able to achieve overall savings of about 35 per cent.

Another important benefit gained from using MTM on these operations was that we were able to define methods much more clearly. When using time study in developing the standard data, we were unable to give a complete written description of the methods on which standards were based. Consequently when looking at the operation again after a lapse of several months, it was always difficult for us to detect creeping methods changes that might have occurred. It was also difficult for us to redefine methods for supervisors and other interested parties.

With standards developed from MTM our methods are defined automatically through the MTM symbols associated with the synthesis of each elemental time value. Now anyone familiar with MTM has little difficulty in understanding the exact methods on which our dowel pin packing standards are based.

We also found that because MTM permitted us to develop such precise methods, additional operator training was required. Because this training was necessary and because of the close contact we had with the supervision during the training period, the time standards became effective sooner than we expected, due primarily, we believe, to the interest and cooperation of the supervision.

Our expectations of the time to attain a satisfactory performance level were based on previous experience with other operations on which standards were derived from time studies and little operator training was thought necessary.

We do not want to create the impression that we used MTM exclusively in developing standards for the dowel pin packing operation. Time study was used to develop the standards for set up operations and to provide us with information on some of the non repetitive elements. We believe that MTM and time study should supplement each other and that the selection of one technique should not exclude the other.

Summary of Dowel Pin Packing and Introduction to "Operation Catalog"

About 600,000 dowel pins are being shipped from Danly each month. They are being packed and labeled by one girl who is performing at a level of about 20% above standards which have been determined from MTM values.

Have we completely improved the operation? I don't think so. Only recently we began compiling a list of possible changes. We will undoubtedly use MTM in our selection of those changes which will be made.

Of course, there is the question of when will we be able to direct our efforts back to Dowel Pin Packing. In addition to a scheduled number of things to do, we are always asked to undertake an unexpected project with very little notification.

For example, one day the Vice President in charge of our Die Set Sales came to me and asked this simple question: "How much should it cost to attach this 'gold label' to this binder?"

I gave a very quick answer, nothing more than a guess (about one cent) not realizing that it might lead to anything other than further discussion.

He informed me that our Advertising Director had been quoted a cost of six cents for the operation. Armed with an opinion of mine, which evidently concurred with his, he headed towards the Advertising Director's office.

About two days later, I was approached by our Advertising Director with a binder, a gold label, and 20 sections of a Die Set Catalog and asked for an estimate of the cost for their complete assembly.

It was necessary for me to convince him that the scope of his request would require a little time to satisfy. He informed me that the longest he could wait was two days.

This is typical of projects which Jack must be prepared to undertake at a moment's notice. For, as you might have surmised, it was Jack Ringham who ended up with the assignment "Operation Die Set Catalog."

Catalog Operation

In order to prepare an estimate of the cost of assembling the catalogs we first had to know how the work would be done. Since we had no concept of how a printing firm would do the assembling and because there was not enough time to find out, we decided to base our estimate on the way we would do the job.

There were 35,000 catalogs to be assembled. Each catalog would be made by inserting twenty different components into a loose leaf type binder. A "gold mark" would be attached to the cover of the catalog and each catalog packed into an individual box. Twenty boxed catalogs would be

placed in a larger carton for storage or for shipment to branches for further distribution to customers.

We procured components for several catalogs and began working out what we thought were practical methods. Our MTM practitioner again played the major role in this project. We had less than two days to prepare our estimates so there was a limitation on our time which prevented extensive detailing planning. Basically we proceeded in the following manner:

1. Determined the form in which the various components would be received.

2. Worked out rough approximations of methods to be used assuming the simple inexpensive aids could be made available.

3. Classified work as being either a direct or indirect operation. Direct operations were those performed in actually assembling or boxing catalogs. Indirect operations were those involved in preparing components for assembly and moving material to and from the workplace.

4. Analyzed motion patterns required for direct operations and calculated the TMU required.

5. Estimated the time required on the indirect operations as a percentage of the direct.

6. Determined the total time required and converted it to dollars.

Incidentally the time for applying the gold mark was 201 TMU which when converted to cost was, surprisingly enough, about 1.2 cent each.

We submitted our estimate to the Advertising Director with the understanding that he would use it to strengthen his position in negotiating with the printers over their price to do the work.

Apparently the printing and binding firms had little respect for our estimates since most of their quotations were at least double our figure. Our estimate was about 60% of that of the lowest quote received. It was not long before we learned that the decision had been made for Danly to do its own catalog assembly. You can guess who was assigned the task of laying our workplaces, designing fixtures and setting up the operation.

Needless to say we felt quite uneasy about the situation. We had experienced the same type of uneasiness previously when we used almost pure guesses to arrive at estimates for other jobs. We felt somewhat the same way in this case even though we had been much more scientific in our approach.

We thought that there might have been something wrong with our assumptions or with the printers' methods. After visiting one of the large job shop printers in the city, we decided that there was nothing wrong with our assumptions. Although the print shop we visited had a large variety of automatic and semi-automatic binding equipment, none of it was suitable for the job we had to do. They had performed work similar to our catalog assembly on several occasions, but had never spent much time working out methods. They would have performed the operation by lining up piles of each of the components on a long table. The catalog would be assembled by having girls walk beside the table, pick up one of each component and assemble the components into binders at the end of the table. We knew that even our hastily conceived methods were better than that.

Nevertheless we were not without some doubts concerning our estimates. We were in effect telling the printing and binding shops that with MTM and other industrial engineering techniques, but no practical experience, we could do their type of work at a lower cost than they could. We were determined to make good on our estimates.

We had an advantage in that there were no "experts" in catalog assembling in our organization. There was no one to tell us "It can't be done that way" or "It has to be done this way."

In any project of this nature we believe it is very helpful to define objectives and intentions before actually beginning the detailed work. Realizing that this would be a new and a temporary operation we set up the following ground rules:

1. Keep the cost of workplaces at a minimum.

2. Make maximum use of existing equipment.

3. If possible, buy equipment that could be used elsewhere after the completion of the catalog operation.

4. Have an incentive operation to insure attainment of our estimates.

We had about two weeks to:

Buy, or design and make equipment.
Develop detailed methods.
Hire or transfer personnel.
Set up a work area.
Establish standards for incentive purposes.

We decided that we would have to determine the physical facilities and personnel required as soon as possible, so that the wheels for obtaining them could be set in motion. In order to determine these things we had to know methods. The methods we had assumed for our estimates needed to be worked out in detail with all variations considered.

Because of the large number of different items going into the catalog, it soon became obvious that all components should not be inserted at once. It appeared impractical to arrange everything at one workplace so that a person could reach all items from one location. In addition it was physically impossible to put all components over the rings of the binder in one operation. The solution to these problems was to insert half of the components in each side of the catalog in two separate operations.

It appeared that the attaching of the gold mark could be combined with packing the catalog into the box. Therefore it looked as though the assembly and packing would be done in three operations performed at three successive work stations. MTM was used to a considerable extent in working out the detailed motion patterns at each of the three work stations and in determining what equipment would be needed. MTM was also helpful in balancing the work to be done at the three stations.

The only equipment we had to have made was a series of racks for holding the catalog components. These were intended to be arranged at the first two work stations so that all components could be placed within easy reach of the assembler. The only other equipment needed consisted of tables, stools, an automatic taping machine and a scotch tape dispenser. We had all the equipment assembled and the workplace prepared several days before work was to begin. This gave us the opportunity to work out some of the fine points in our methods, and to be sure that the job could be done the way we planned.

Our final method was as follows:

First Work Station:

Get binder
Open rings
Assemble 9 components
Place 9 components into binder
Pass binder to second work station

Second Work Station:

Get binder
Assemble 11 components
Place 11 components into binder
Close rings
Aside catalog

Third Work Station:

Get catalog
Place on pile of cardboard box flats
Apply gold mark
Fold box
Get gummed tape
Apply tape to seal box
Aside box

It was determined that one indirect worker would be necessary to pack the finished boxes of catalogs into cartons and to keep the three work stations supplied with materials.

When the methods were firmly established we computed the TMU for the operations at each of the three work stations. The boxing operation took slightly longer than the other two and therefore controlled the output. Our accurately established standards indicated a slightly higher output than previously determined from our estimates which gave us considerable reassurance. The only step remaining was to train people to do the work in the standard time allowed.

It had been decided to hire high school students to do the work on a part time basis. Three girls were selected to do the assembling and boxing operation while the indirect work of material handling was to be done by a boy. There were two advantages in selecting the personnel we did. First, they did not require a high base wage. Secondly they were anxious to learn their new jobs quickly and were eager to show how well they could do. The man who developed the MTM standards conducted the necessary operator training. In the work he had done to establish methods, he gained considerable proficiency in doing the operations himself. He was in a good position not only to explain how the work should be done, but also to demonstrate personally.

Because of the interdependence of all the operations we decided to use a group incentive plan. This type of plan also minimized problems of timekeeping and maintaining counts of work completed.

In the first few days of training, primary emphasis was placed on proper methods and although the time standards had been published we stressed the point that it would probably take several weeks before they would be met.

Actually the performance against the standards in the first few days was from 50 to 60 per cent which we considered good.

The girls were all trained in each of the three operations and they rotated from one job to another. This minimized the monotony of the work and also avoided having the same girl always performing the boxing operation which was controlling the bonus earnings of the group.

It took about two weeks for performance against the standards to reach 100 per cent. During this time our attention to the operation gradually diminished as we saw things progressing smoothly. In another two or three weeks performance reached 120 to 125 per cent where it remained for the duration of the operation.

We have a few pictures of the operation which should illustrate what was involved.

The picture above shows the first work station where the girl would get a binder from the pile in the foreground, open it, gather and insert the components and slide the binder across the table towards the second work station.

At the second work station the girl would assemble the remaining components, place them in the partially filled binder on her left, close the binder and place it on the table to her left.

At the third work station an assembled catalog was picked up from the pile in the right foreground and placed on top of a pile of cardboard flats. The gold mark was picked up with the left hand and applied with scotch tape obtained with the right hand. The flat was folded around the catalog to make the box, and was then sealed with gummed tape dispensed from the large machine shown. The box was then placed on a table to the left where it was packed by the material handler.

The picture on the next page shows an overall view of the operation including the material handler at the left.

In "Operation Catalog" we not only met our original cost estimates but we also gained considerable knowledge from our experiences. Our confidence in MTM was greatly increased by our work on this project because we used it as a valuable tool in all our efforts.

In summarizing we can bring out that MTM played an important role in the following areas:

1. Cost estimating.
2. Establishing method and workplace layout in advance of production.
3. Selecting equipment.
4. Balancing the line.
5. Developing incentive standards.
6. Training operators in proper methods.

We have used MTM in other projects to solve specific problems but it was through "Operation Catalog" that we gained a real appreciation of the many uses of MTM. We hope to use MTM even more in the future and anticipate that our next applications will be in light assembly operations.

During the course of our experience with "Operation Catalog" and "Dowel Pin Packing" we learned of many of the useful applications of MTM which we have tried to bring out. We know that many job shop operations do not lend themselves to MTM analysis. The characteristics of operations to which we believe MTM can be applied effectively are as follows:

1. The operations that are primarily operator controlled. It would ordinarily be impractical to use MTM on an operation which is 90% machine controlled.

2. The combination or sequence of elements varies. This, of course, is typical of job shop operations.

3. Individual elements are relatively standard. In too many cases people see only the differences in job shop operations whereas they should look for similarities. Standardization can be used to make similarities out of differences.

Even though MTM is not suitable for application to a complete operation it can often be used to advantage on several elements of an operation. In building standard data we have used MTM to determine the time for "odds and ends" elements which we know will occur but for which we have insufficient time study information. Occasionally in synthesizing standard data, methods become apparent which are better than those observed in the original time studies. MTM can often be used to develop times for the better methods, eliminating the need for additional time studies.

You can see that we believe that Methods Time Measurement belongs in the tool kit of the industrial engineer confronted with the problems of improving job shop operations.

USE OF MTM IN ESTABLISHING DATA AND STANDARDS FOR LIGHT MACHINING OPERATIONS

by
Wallace E. Witt
Durant Manufacturing Company

Before getting into the subject, it would be well to give you a little background and company history that led us into the use of MTM.

Durant Manufacturing Company is one of the leaders in the field of mechanically and electrically actuated counting devices for industry, military and scientific use; and the present age of electronics and precision instrumentation has opened an entirely new field for the use of precision, low torque, digital read-out devices.

Our Company, while small as plants go (total of 150 production workers in two plants), manufac tures nearly 400 standard production models plus an X number of specials to meet users' specific requirements.

We fabricate approximately 7,000 different parts. In assuming an average of four operations per part, simple arithmetic will show the terrific problems we faced in setting incentive standards.

Durant has had an incentive program for many years, starting with a straight piece-work plan, which eventually was changed to a standard hour plan by mathematical conversion.

Over the years thousands of standards were set by stop watch time study, and from time to time small areas were partially covered by standard data.

As time went on, many of these rates became extremely loose or, in many cases, tight due to creeping changes in material, tools, equipment, and not the least lack of precise detail--which, coupled with changing personnel, both in the shop and in the time study department, brought us to the point where standard rates were just about anything but standard.

Management and Union both recognized that something had to be done, and the Company embarked on a long-range program of building standard data which would be able to stand the test of time.

We started out by using stop watch time studies to gather the data in our drill press department and, in fact, did start using the data for applying rates. But we soon found that this data was sour. A careful analysis of the situation disclosed that our time study people had gone sour on leveling, due largely to lack of enough good operators to make the studies on. It was further found that many of the elements were too broad in their scope, so that in some cases the element would be tight and in other cases the element would be loose.

At this time we decided to go ahead with an MTM program. We engaged a management consultant to set up an in-plant training program for all methods and time study people plus three union officers (the union having previously said "No" to the use of MTM). However, our contract expressly states that standards can be set by any approved industrial engineering technique, and upon that basis we proceeded.

Upon completion of the course, we started developing data in our hand screw machine department. Our first job was to standardize tooling for all of the machines in the department. We found some of the operators using tools of their own design, some machines equipped differently than others, etc. And if data are to be kept as simple as possible, you must standardize your methods.

On the basis of this analysis, we threw out all make-shift tools and supplied each machine with a basic set of collets, tool holders, and certain basic cutting tools. We also purchased a sufficient quantity of specialized tools, which are kept in the crib for the use of all operators. In this way all operators could be reasonably expected to set up their jobs in a consistent manner.

Out next approach was a complete analysis of the types of tools, method of operation, and basically the fundamental motion patterns that occur in operating the machine. We were very fortunate in this respect in that we had recently promoted an ace setup man and former operator to the Methods Department just in time to get the MTM training.

It was decided to analyze the motion patterns by the tool location, for example: cross slide, turret, etc. Sketches were then made of specific machine sections so that all possible motion patterns could be drawn in on each.

Actual motion patterns were then tried at the machine and measurements taken for their reaches

and moves. A careful check was then made to determine the average distance for our type of work, and in each case we attempted to be a little on the loose side for distances moved or reached--so that we could be sure that the resulting value for the element would be applicable in all cases.

You will note that many of the elements are broken down with separate values for "Advance" and "Return." Why not combine into one element? In many cases combining would simplify the data and reduce the number of elements. However, we took the approach that we should stay with a minimum number of values for an element, but that the elements themselves should also be as simple as possible and not compounded with other elements, so that simultaneous motions could be the more readily recognized and circled out.

Each manual element that you see on the rate card (Figures 1 and 2, a and b) was so analyzed, after which an MTM analysis was made and a time value assigned in terms of minutes per piece.

This method was used for all manual cycle elements, including getting bar from rack and loading bar tube.

To cover the variable nature of in-process inspection on the part of the operator, we made a series of stop watch time studies, the results of which appear in Table 2 (Figures 1a and 2a).

For machine times, a basic machining table in terms of minutes per inch of cut was set up, based upon surface feet per minute for spindle speed and the expected chip load for a simple operation such as facing. This simple table becomes the basis for all turning values when used in conjunction with one of the cutting factors, which serve to adjust the basic machine time in line with the type of tool and/or finish involved in the particular cut.

When it comes to setups, we decided the most practical approach would be a rather lengthy series of time studies covering the different types of tools and combinations.

The various values for the different tools include both place and remove and the initial setting of the tool to a loose tolerance of approximately .005±.

After accruing values for each element for the entire set of data, the next logical step was to determine an easy method of application.

With simplicity the keynote, we designed the rate card and the setup and detail card which you have before you (Figures 1 and 2, c and d). But more about that later.

With any set of data, it is very important that a permanent set of instructions be set up to act as a consistent guide to all analysts, both present and future. In this set of instructions, each element should be thoroughly described to prevent any future argument as to precisely what the data covers. It is also advisable for each analyst using the data to periodically re-read the manual to keep himself in the groove.

For each set of data we have made it a practice to design a specific setup and detail card for the type of operation involved. Taking the latest setup and detail card (Figures 1c and 2c), you will note that we have a plan facsimile of the possible tool locations of a turret lathe or screw machine. Specifically, #1 represents the collet, #2 the front cross-slide tool, and #3 the rear cross-slide tool position; and #4 through #9 represent the six turret positions. In this way we can simply but adequately describe a setup by writing down the tool, tool size, tool location and number, the type of steel, the speed and feed and coolant for each tool set up in the machine. Then it is only necessary for the operator to follow the numerical sequence and position to be able to consistently set up his machine from job to job, regardless of the time lapse between lots.

The face of the setup card also contains other information, which is simply checked off to aid the operator further in setting up his job.

On the back of the card (Figures 1d and 2d), we supply a detailed operation sequence which is actually a word picture of the motion patterns which the operator goes through for one complete cycle.

We will continue our discussion now with an actual run-down of a job which is a cam roller made from 1/4" diameter free turning brass. The operation consists of centering, drilling, facing, turning, filing, and cutting off.

Taking the setup card we list the tools in order, as stated previously; and then on the back of the card under "Operation Sequence" we find the following: The right hand advances the center drill and centers; returns the center drill and indexes; advances the drill and drills; returns the drill and indexes again; advances the bumper. At this time the left hand opens the collet, allowing the bar feed to push the stock out to the bumper, and the left hand closes the collet;

again the right hand takes over and returns the bumper, single indexes and advances the end mill; faces and returns the end mill; and then makes a multiple index bringing the center drill back into position again. At this point the left hand advances the turning slide, adjusts the slide to the work, makes a long turn and then advances the cut-off tool from the rear. While the left hand is advancing the cut-off tool, the right hand picks up a file. The left hand then makes a partial cut and dwells while the right hand files during the dwell; then the left hand finishes the cut-off while the piece drops into the right hand. Then as the left hand returns the cut-off tool to neutral, the right hand disposes of the piece and then asides the file; which is the end of the operational sequence.

With this word picture of the operation, we then take the lathe rate card, and with red pencil or ink we mark in the frequency that each element occurs and extend total time for the element in the time column. As we go along we circle out those elements which appear to be limited out by a larger element.

We then pick out the proper basic machine time, which is circled for future reference, and we also circle the cutting factors that are to be used. We then post the basic machine time and the cutting factors in the proper space under "Element 25 Machine Time," calculate the length of cut and post it, and then extend to a net machine time per cut. We then determine the inspection allowances and post an "Element 24," after which all the element values that are to be used are added together for total minutes per piece, in this case .462, to which is applied our constant conversion factor of 1.83 (which converts minutes per piece into standard hours per 100 pieces, and automatically includes 10% for PRandD, which is contractual).

At this point it is well to emphasize the fact that basic MTM values already include an incentive potential of 20-25%. Our basic machine values also include 20% by contract, so you will see that the resulting standard of .85 hours per 100 pieces for the above example includes all the necessary incentive potential.

What has our experience been with this actual job? In the four times that the job has been run against this rate, the average performance has been 130%.

By contrast, let us take another job (Figure 2a-d) which has roughly one-fourth the cycle time of our previous example. This particular job is a pinion shaft made out of 1/8" C.R. Steel, and the operation is knurling one end as a final operation. The operation requires only a collet and a collet stop, plus a knurling tool and an extension on the tip. The operation sequence is as follows: Right hand picks up piece, places part in collet, and moves piece to stop. Left hand closes collet; right hand indexes tool in position, advances knurling tool, knurls, and returns knurling tool, left hand opens collet while right hand indexes knurling tool out of position; right hand then moves piece out and removes from collet and disposes from piece; which completes the operational cycle.

This job has been run a total of six times in the last ten months by five different operators, and the average gain has been 129%. The lowest earnings being 123% and the highest, 136%.

These are just two examples, but you may ask, "What has the department done as a whole?" The answer is simple: Seven operators working against the new rates (and all statistics are based on the new rates) have averaged 124% over the last year, with an individual operator spread from 96% to 139%.

If for statistical purposes we remove the one sub-standard operator, we then have six operators ranging from a low of 122% to a high of 139%, with an average of 128%.

How is this data now used?

1. To set rates on any unrated jobs now in our files.

2. To make estimates on any new products.

3. To replace any old rate upon which there has been a change in one or more elements.

4. To replace any old rate which has been grieved by an operator.

You may question those last two items, and rightly so, because we do have the usual incentive clause in our contract which guarantees the operator that there shall be no changes in rates except to cover changes in tooling, methods, materials, etc., and only those elements so affected can be changed.

When we went into this standard data program, we negotiated an amendment to this clause which reads: "It is further agreed that where there is a change affecting a standard established on a basis other than on the newly developed standard data, or an employee requests a recheck or restudy of such standards, a restudy of the entire job may be made to establish the new standard. This restudy shall include both the production and setup standards."

Now to summarize our standard data program at Durant. In the early part of my talk I mentioned the fact that the motivating factor which led us into an MTM program was our sad experience in the drill press department. You will be interested to know that with the use of MTM as a guide for re-evaluation of our leveling, we were able to bring this data into focus. We also used MTM to re-evaluate and spread out some of those elements which had been too broad in their scope.

At present we are engaged in a standard data program, with the use of MTM, in our Sub-Assembly Department. This department is composed primarily of light bench work, arbor presses, small air hydraulic presses, spinners, riveters, etc. Our approach in this case is to set rates directly by MTM inasmuch as they are very short cycle, with the intention of cataloging the basic elements of these rates to the tent that we can build a simplified set of data.

I do not mean to imply by this that we have thrown our stop watches away. Heaven forbid! In such areas as our final assembly, where there is a great deal of positioning and fitting of extremely small parts, and where the overall cycle time of the complete assembly is from 3 to 15 minutes, we are continuing to use stop watch time studies to gather our data. However, we do keep ourselves in line with an occasional MTM analysis of a complete assembly.

What does this program mean to Durant? In the approximately one year that we have been applying new standard data rates, we have applied as of this moment approximately 2,150 operational job rates. By that I mean that 2,150 different job operations have had not only the production rate established but also both a complete setup rate for each operation (for those operators who set up their own jobs) and a job change rate (for those operators whose job is set up by a setup man). Each of these 2,150 jobs is covered by a setup and detail card similar to the one you have in your hand.

Five hundred and thirty of these job rates were set for Hardinge hand screw machine jobs, for which I had previously given you performance statistics.

How is this program affecting our direct labor? Our Cost Department keeps a rather close check on the 26 major stock models, and in analyzing these figures we find that the total direct labor involved (that is, all direct labor from fabrication of parts through final assembly) has gone down an average of 13% during the period in which we have been concentrating on application of new data rates.

Are we sold on MTM? The answer to that is that one of the newer members of the industrial engineering staff is starting his three-week MTM training course right here in Chicago this coming Monday.

(Figure 1 a) FORM NO. 888

HARDINGE LATHE RATE CARD

OPER. NO.	OPERATION DES.	MACH. NO.	PART NAME	PART NO.
10	Ctr, Drill, Face, Turn, File & Cutoff	107	Cam Roller	AA-5642.1 B

MATERIAL	CHANGE - DATE	SPEED	DATE	BY	SET-UP	STD. HRS.
1/4" ϕ Free Turning Brass		2370	1/16/57	E.S.	S. .53 O. .12	.85

ELEMENTS

ELEMENT DESCRIPTION	UNIT	FREQ.	TIME
1) CROSS SLIDE	XXX	XXX	XXX
A) ONE TOOL ADVANCE	.017	1	.017
B) TWO TOOL ADVANCE	.024	1	.024
C) RETURN	.005	1	.005
2) TURNING SLIDE ADJUST	.014	1	.014
3) TURRET	XXX	XXX	XXX
A) ADVANCE	.018	4	.072
B) RETURN	.009	4	.036
C) SINGLE INDEX	.009	3	.027
D) MULTIPLE INDEX	.021	1	.021
4) COLLET	XXX	XXX	XXX
A) OPEN (BAR STOCK)	.009	1	.009
B) OPEN (CHUCK WORK)	.016		
C) CLOSE	.009	1	.009
5) PLACE PART IN COLLET	XXX	XXX	XXX
A) ROUND PIECE	.019		
B) ONE WAY ONLY	.024		
6) REMOVE PC. FROM COLLET	.003		
A) FALLS FROM COLLET	XXX		XXX
7) ADD PER IN. OF MOVE			
IN AND OUT	.0015		
8) PLACE PC. ON ADAPTOR	.028		
9) REMOVE PC. FROM ADAPTOR	XXX	XXX	XXX
A) LOOSE FIT	.017		
B) TIGHT FIT	.019		
C) DROPS OFF	XXX	XXX	XXX
10) DISPOSE OF PART	XXX	XXX	XXX
A) GRAVITY	XXX		XXX
B) IN PAN	.010	1	.010
C) ON SPINDLE	.020		
11) MOVE PC'S ALONG CHUTE	.010		
MISC.			
SUB TOTAL TIME			.239

ELEMENTS

ELEMENT DESCRIPTION	UNIT	FREQ.	TIME
12) REMOVE PC FROM SPINDLE	.005		
13) STOP & START	.019		
14) BLOW OFF PC. - COLL'T.-ADP'T.	.028		
15) CLEAR CHIPS FROM HOLE	.012		
16) LUBE TAP, DRILL, REAM	.025		
17) FILE	XXX	XXX	XXX
A) PICKUP & FILE WHILE MACH.	.015		
B) PICKUP & FILE	.021	1	.021
C) FILE (PALMED)	.006		
D) FILE ASIDE	.007	1	.007
18) CHG. SPEED & DIRECTION	.012		
19) PUT PC. ON & OFF ARBOR	.220		
20) PUT PC. ON & OFF MANDREL	.246		
21) ADVANCE ST'K BY HAND	.027		
22) ADVANCE BAR STOCK — PER IN. X PC. LENGTH: .0012 X .535			.001
23) LOAD BAR IN MACH — TIME ÷ (142" ÷ PC. LG. = NO. PC'S): .702 ÷ 265			.003
24) INSPECTION			XXX
25) MACHINE TIME			XXX

1ST	2ND	3RD	4TH	5TH	TOTAL		
.118	.221	.016	.163		.598	1/15	.040

OPERATION	UNIT	LENGTH	FAC.	FREQ.	XXX
1) Center	.025			1	.025
2) Drill	.067	.535	1.0	1	.036
3) Face	.101	.035	1.0	1	.004
4) Long Turn	.101	.490	1.5	1	.074
5) Cut off	.101	.094	1.3	1	.012
6)					
7)					
8)					

→	.239
TOTAL MINUTES PER PC.	.462
CONVERSION FACTOR	1.83
PROD. STD. HRS. PER 100 PC'S.	.85

MACHINE TIME — TABLE I

	BRA. & ALUM. .005 FEED 300 S. F./M.		C.R.S. & EV. .004 FEED 160 S. F./M.		STAIN ST'L .003 FEED 120 S. F./M.	
SPEED	ST'K DIA.	TIME MIN.	ST'K DIA.	TIME MIN.	ST'K DIA.	TIME MIN.
3500	.330	.069	.174	.086	.131	.114
2370	.490	.101	.258	.126	.193	.169
1800	.640	.133	.339	.166	.237	.222
1590	.725	.151	.384	.189	.288	.252
1200	.960	.200	.510	.318	.381	.333
790	1.449	.304	.775	.483	.581	.507
460			1.328	.652	.996	.870
230					1.998	1.740

CUTTING FACTOR		ADD TO CUT LENGTH
CUT OFF	1.30	1/2 OF CUTOFF TOOL WIDTH
CHAMFER	1.00	.010 TO CUT DEPTH
FACE	1.00	.020 TO CUT DEPTH
LG. TURN (FINISH)	2.50	.010 FOR APPROACH
LG. TURN (ROUGH)	1.50	.010 FOR APPROACH
KNURLING	.50	.010 FOR APPROACH
FORM:		.010 TO CUT DEPTH

USE CUTTING FACTORS AS SHOWN. WIDTH OF TOOL IS COMBINED ACTUAL CUTTING EDGES.

1/8	1/4	3/16	1/4	5/16	3/8	7/16	1/2
1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00

INSPECTION — TABLE II

TYPE	TIME	TYPE	TIME
1 DIAMETER	.118	1 LENGTH	.163
2 DIAMETER	.175	2 LENGTH	.198
3 DIAMETER	.275	3 LENGTH	.342
PLUG SIZE & CON.	.221	DEPTH CHECK	.149
PLUG SIZE	.096		
INSPECTION FREQ.	1/15		

REFER TO INSP. FREQUENCY SHEET

THREADING FORMULAS

CEN. DRILL — TABLE III

SIZE	TIME
C-2 1/4	.030
E-1 9/32	.025
E-2 1/8	.023
F-2 7/32	.028

REFER TO MANUAL FOR FORMULAS ON CHASING & TAPPING

(Figure 1 b)

NOTE: ALL MACHINE TIMES OF THE TABLES INCLUDE 20% INCENTIVE

*ADD TO DRILL DEPTH

**ADJUST TO TOLERANCES
EXACT .000→.002
CLOSE .0021→.005
LOOSE .0051→+

*** RE-REAM – USE BRASS VALUES
CT'R SINK-USE DIA. OF DRILLED HOLE

SETUP ELEMENTS	TIME	OCC.	
1) JOB CHANGE (CONSTANT)			
WALK PUNCH IN & OUT			
GET TOOLS FROM CRIB			
TRANSPORT TOOLS TO JOB			
GET JOB (MATERIAL)	XX	XXX	7.20
STUDY B. P. & ROUTING			
CLEAN MACHINE			
COLLET			
TURRET (POSITIONING)			
2) CROSS SLIDE TOOLS	XXX	XXX	XXX
CUTOFF	3.30	1	3.30
FRONT POST	2.40		
REAR POST	2.40		
CIRCULAR FORM	2.75		
MULTIPLE TOOL POST	4.15		
TURNING SLIDE	2.30	1	2.30
OVERHEAD CUTOFF	2.95		
3) TURRET TOOLS	XXX	XXX	XXX
BUMPER	1.35	1	1.35
CENTER (CHUCK)	2.15	1	2.15
DRILL (CHUCK)	2.15	1	2.15
REAMER (FLOATING HOLDER)	1.80		
GOOSENECK	2.65		
TAP HOLDER	1.80		
GEOMETRIC DIE HEAD	2.00		
KNURLING TOOL	1.40		
FACING TOOL	1.45		
END MILL	1.50	1	1.50
REVOLVING CENTER	1.20		
EXTENSION	.30	1	.30
4) GUARD	.50		
5) BAR GUIDE	.50	1	.50
6) INSIDE STOP	1.30		
7) BACK STOP	1.60		
8) ADJUST ALLOWANCES**	XXX	XXX	XXX
ONE PER CLOSE TOLERANCE	.55	1	.55
ONE PER EXACT TOLERANCE	1.10		
9) BLUE PRINT CHECK	XXX	XXX	XXX
ONE PER DIMENSION	.25	3	
10) CYCLE TIME FOR (1) PC.	XXX	XXX	.46
MISC.			
TOTAL SETUP ELEMENTS			22.51
12) JOB CHANGE ONLY			
WALK, PUNCH IN & OUT			1.62
CLEAN MACHINE			1.00
CYCLE TIME FOR (1) PC. (ITEM 10)			.46
INSPECTION (ITEM 11)			2.77
TOTAL JOB CHANGE ELEMENTS			5.85

DRILL - REAM - CT'R BORE — TABLE IV

DRILL SIZE				BRASS & ALUM. 300 S.F./M.			EV.&NAV.&C.R.S. 100 S.F./M.			STL'S 70 S.F./M.		
DIA.	NO/L.	FRAC	D.P. IN *	R.P.M.	TIME BR.	TIME AL.	R.P.M.	TIME EV.NA.	TIME C.R.S.	R.P.M.	TIME ST'S.
.040	60		.014	3500	.178	.228	3800	.187	.345	2370	.479
.047	56	3/64	.016		.156	.182		.160	.275		.378
.063	52	1/16	.021		.130	.141		.132	.203		.294
.078	47	5/64	.026		.110	.116		.115	.162		.232
.094	42	3/32	.032		.092	.098		.101	.134		.188
.109	36	7/64	.037		.076	.085		.092	.115		.153
.125	30	1/8	.042		.064	.078	2370	.083	.102	1600	.144
.141	28	9/64	.052		.057	.073		.078	.093		.137
.156	22	5/32	.058		.052	.070		.073	.088	1200	.134
.172	17	11/64	.063		.048	.068	1800	.072	.087		.134
.188	12	3/16	.068		.046	.067		.073	.088		.137
.203	6	13/64	.073		.044	.066		.077	.092	1200	.140
.219	2	7/32	.078		.043	.067	1600	.082	.100		.150
.234	A	15/64	.084		.044	.067		.087	.110		.163
.250	E	1/4	.094		.045	.068	1200	.094	.122	700	.183
.281	K	9/32	.105		.046	.068		.102	.133		.203
.313	O	5/16	.115		.049	.069		.112	.147		.224
.344	S	11/32	.125	2370	.052	.069	700	.121	.161	490	.251
.375	V	3/8	.147		.056	.070		.134	.178		.287
.438		7/16	.167		.060	.071		.148	.200		.325
.500		1/2	.188		.063	.072		.165	.230		.366

OPERATION FACTORS			
REAM	.12	COUNTERBORE	2.00
***RE-REAM	.12	SPOTFACE	1.25
COUNTERSINK	1.00		

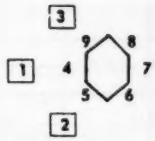
TOOL RELIEF FOR CLEARING CHIPS
DRILL - (DEPTH + DIA – 4)
COUNTERBORE - (DEPTH + ¼ DIA. – 2)

INSPECTION ELEMENTS	TIME	OCC.	TOTAL MIN.
11) INSPECT FIRST PIECE			
WALK TO-INSP.-WAIT-RETURN	XXX	XXX	.97
LOCATE TOOLS			
THREAD GAGE	.50		
PLUG GAGE	.15	1	.15
INDICATOR	.10	1	.10
MIKE	.10	1	.10
INSPECTION PROCEDURE			
THREAD GAGE	.25		
PLUG GAGE	.10	1	.10
SCALE DEPTH OR LENGTH	.35		
MIKE DEPTH	.45		
MIKE DIMENSIONS	.50	2	1.00
INDICATE DIMENSIONS	1.92		
CONCENTRICITY	.35	1	.35
COMPARATOR	3.00		
MISC.			
TOTAL INSPECTION			2.77

→	22.51
TOTAL MIN. FOR SETUP PROCEDURE	25.28
CONVERSION FACTOR	.021
STANDARD HRS. PER SETUP	.53
STANDARD HRS. PER JOB CHANGE	.12

OPERATION NUMBER 10 — **LATHE SETUP & DETAIL CARD** — PART NUMBER AA-5642-1-B

DATE 1-16-57



	TOOL	TOOL SIZE	TOOL LOC. & NO.	T. STL.	SPD.	FD.	CL.
	1. Collet	1/4"	Mach.				
3	2. Turning Slide	5/16" Bit	Lc. 500	HS	2370	HD	SO
	3. Cutoff Post	1/16" Bld	Mach.	HS	2370	HD	SO
	4. Chuck (Center	#13	Crib	HS	2370	HD	SO
1	5. Chuck (Drill	#30	Crib	HS	2370	HD	SO
	6. Bumper & Extension	2-1/4"	Mach.				
2	7. End Mill (Face)	D-422	Mach.	HS	2370	HD	SO
	X (2) Alco Chucks		Lc. 500				
	X (1) Extension		Lc. 500				

MISCELLANEOUS ELEMENTS	FREQ.
1. FILE BURRS	1
2. CLEAN PART – CLOSE DIM. ONLY	
3. PLACE PC. IN COLLET	
4. PLACE PC. ON ADAPTOR	
5. PRESS PC. ON MANDREL	
6. PLACE PC. IN FIXTURE	
7. PLACE PC. IN CHUCK	
8. STACK PC. IN SKID	
9. PLACE PC. IN PAN	1
10. PLACE PARTS ON SPDL.	
11.	
12.	

COOLANT	SYM.
SOLUBLE OIL	SO
CUTTING OIL	CO
JOHNSON WAX & WATER	JW

INSPECTION	FREQ.	INSPECTION	FREQ.
PLUG GAGE	1/15	DEPTH	
CONCENTRICITY	1/15		
LENGTH	1/15		
O.D.	1/15		

SKETCH & REMARKS

Mike needed 0-1"

Have slight radius on Tool Bit to give a better finish when turning O.D.

(Figure 1 c)

COPY

FORM NO 664

OPERATION SEQUENCE
Advance Center
Center
Return Center
Index (S)
Advance Drill
Drill
Return Drill
Index (S)
Advance Bumper
Open Collet
Close Collet
Return Bumper
Index (S)
Advance End Mill
Face
Return End Mill
Index (Mult)
Advance turning slide
Adjust slide to work
Advance Cutoff
Cut-dwell-cutoff
Return to neutral
Pick up file
File during dwell
Dispose of piece
Aside file

(Figure 1 d)

HARDINGE LATHE RATE CARD (Figure 2 a)

FORM NO. 668

OPER. NO.	OPERATION DES.	MACH. NO.	PART NAME	PART NO.
40	KNURL (1) END	107	PINION SHAFT	AA-7342

MATERIAL	CHANGE - DATE	SPEED	DATE	BY	SET-UP	STD. HRS.
1/8" ϕ C.R.S. F1112		3500	11/3/56	E.S.	S. .29 O. .10	.22

ELEMENTS

ELEMENT DESCRIPTION	UNIT	FREQ.	TIME
1) CROSS SLIDE	XXX	XXX	XXX
A) ONE TOOL ADVANCE	.017		
B) TWO TOOL ADVANCE	.024		
C) RETURN	.005		
2) TURNING SLIDE ADJUST	.014		
3) TURRET	XXX	XXX	XXX
A) ADVANCE	.018	1	.018
B) RETURN	.009	1	.009
C) SINGLE INDEX	.009	1/2	.0045
D) MULTIPLE INDEX	.021	1	.021
4) COLLET	XXX	XXX	XXX
A) OPEN (BAR STOCK)	.009		
B) OPEN (CHUCK WORK)	.016	1	.016
C) CLOSE	.009	1	.009
5) PLACE PART IN COLLET	XXX	XXX	XXX
A) ROUND PIECE	.019	1	.019
B) ONE WAY ONLY	.024		
6) REMOVE PC. FROM COLLET	.003	1	.003
A) FALLS FROM COLLET	XXX		XXX
7) ADD PER IN. OF MOVE			
IN AND OUT	.0015	2	.003
8) PLACE PC. ON ADAPTOR	.028		
9) REMOVE PC. FROM ADAPTOR	XXX	XXX	XXX
A) LOOSE FIT	.017		
B) TIGHT FIT	.019		
C) DROPS OFF	XXX	XXX	XXX
10) DISPOSE OF PART	XXX	XXX	XXX
A) GRAVITY	XXX		XXX
B) IN PAN	.010	1	.010
C) ON SPINDLE	.020		
11) MOVE PC'S ALONG CHUTE	.010		
MISC.			
SUB TOTAL TIME			.108

ELEMENTS

ELEMENT DESCRIPTION	UNIT	FREQ.	TIME
12) REMOVE PC FROM SPINDLE	.005		
13) STOP & START	.019		
14) BLOW OFF PC. - COLL'T.-ADP'T.	.028		
15) CLEAR CHIPS FROM HOLE	.012		
16) LUBE TAP, DRILL, REAM	.025		
17) FILE	XXX	XXX	XXX
A) PICKUP & FILE WHILE MACH.	.015		
B) PICKUP & FILE	.021		
C) FILE (PALMED)	.006		
D) FILE ASIDE	.007		
18) CHG. SPEED & DIRECTION	.012		
19) PUT PC. ON & OFF ARBOR	.220		
20) PUT PC. ON & OFF MANDREL	.246		
21) ADVANCE ST'K BY HAND	.027		

22) ADVANCE BAR STOCK — PER IN. X PC. LENGTH .0012 X — XXX

23) LOAD BAR IN MACH — TIME ÷ (142" ÷ PC. LG. = NO. PC'S) .702 ÷ — XXX

24) INSPECTION — XXX

1ST	2ND	3RD	4TH	5TH	TOTAL		
.118					.118	1/25	.005

25) MACHINE TIME — XXX

OPERATION	UNIT	LENGTH	FAC.	FREQ.	XXX
1) KNURL	.086	.197	.5	1	.008
2)					
3)					
4)					
5)					
6)					
7)					
8)					

	.108
TOTAL MINUTES PER PC.	121
CONVERSION FACTOR	1.83
PROD. STD. HRS. PER 100 PC'S.	.22

MACHINE TIME — TABLE I

	BRA. & ALUM. .005 FEED 300 S. F./M.		C.R.S. & EV. .004 FEED 160 S. F./M.		STAIN ST'L .003 FEED 120 S. F./M.	
SPEED	ST'K DIA.	TIME MIN.	ST'K DIA.	TIME MIN.	ST'K DIA.	TIME MIN.
3500	.330	.069	.174	.086	.131	.114
2370	.490	.101	.258	.126	.193	.169
1800	.640	.133	.339	.166	.237	.222
1590	.725	.151	.384	.189	.288	.252
1200	.960	.200	.510	.318	.381	.333
790	1.449	.304	.775	.483	.581	.507
460			1.328	.652	.996	.870
230					1.998	1.740

INSPECTION — TABLE II

TYPE	TIME	TYPE	TIME
1 DIAMETER	.118	1 LENGTH	.163
2 DIAMETER	.175	2 LENGTH	.198
3 DIAMETER	.275	3 LENGTH	.342
PLUG SIZE & CON.	.221	DEPTH CHECK	.149
PLUG SIZE	.096		
INSPECTION FREQ.	1/25		

CUTTING FACTOR		ADD TO CUT LENGTH
CUT OFF	1.30	1/2 OF CUTOFF TOOL WIDTH
CHAMFER	1.00	.010 TO CUT DEPTH
FACE	1.00	.020 TO CUT DEPTH
LG. TURN (FINISH)	2.50	.010 FOR APPROACH
LG. TURN (ROUGH)	1.50	.010 FOR APPROACH
KNURLING	.50	.010 FOR APPROACH
FORM:		.010 TO CUT DEPTH

USE CUTTING FACTORS AS SHOWN. WIDTH OF TOOL IS COMBINED ACTUAL CUTTING EDGES.

1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2
1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00

CEN. DRILL SIZE	TABLE III TIME
C-2 1/16	.030
E-1 3/32	.025
E-2 1/8	.023
F-2 5/16	.028

REFER TO INSP. FREQUENCY SHEET

THREADING FORMULAS

REFER TO MANUAL FOR FORMULAS ON CHASING & TAPPING

(Figure 2 b)

NOTE: ALL MACHINE TIMES OF THE TABLES INCLUDE 20% INCENTIVE

*ADD TO DRILL DEPTH

**ADJUST TO TOLERANCES

EXACT .000→.002

CLOSE .0021→.005

LOOSE .0051→ +

*** RE-REAM – USE BRASS VALUES
CT'R SINK-USE DIA. OF DRILLED HOLE

SETUP ELEMENTS	TIME	OCC.	
1) JOB CHANGE (CONSTANT)			
WALK PUNCH IN & OUT			
GET TOOLS FROM CRIB			
TRANSPORT TOOLS TO JOB			
GET JOB (MATERIAL)	XX	XXX	7.20
STUDY B. P. & ROUTING			
CLEAN MACHINE			
COLLET			
TURRET (POSITIONING)			
2) CROSS SLIDE TOOLS	XXX	XXX	XXX
CUTOFF	3.30		
FRONT POST	2.40		
REAR POST	2.40		
CIRCULAR FORM	2.75		
MULTIPLE TOOL POST	4.15		
TURNING SLIDE	2.30		
OVERHEAD CUTOFF	2.95		
3) TURRET TOOLS	XXX	XXX	XXX
BUMPER	1.35		
CENTER (CHUCK)	2.15		
DRILL (CHUCK)	2.15		
REAMER (FLOATING HOLDER)	1.80		
GOOSENECK	2.65		
TAP HOLDER	1.80		
GEOMETRIC DIE HEAD	2.00		
KNURLING TOOL	1.40	1	1.40
FACING TOOL	1.45		
END MILL	1.50		
REVOLVING CENTER	1.20		
EXTENSION	.30	1	.30
4) GUARD	.50		
5) BAR GUIDE	.50		
6) INSIDE STOP	1.30	1	1.30
7) BACK STOP	1.60		
8) ADJUST ALLOWANCES**	XXX	XXX	XXX
ONE PER CLOSE TOLERANCE	.55		
ONE PER EXACT TOLERANCE	1.10	1	1.10
9) BLUE PRINT CHECK	XXX	XXX	XXX
ONE PER DIMENSION	.25	2	.50
10) CYCLE TIME FOR (1) PC.	XXX	XXX	.12
MISC.			
TOTAL SETUP ELEMENTS			11.92
12) JOB CHANGE ONLY			
WALK, PUNCH IN & OUT			1.62
CLEAN MACHINE			1.00
CYCLE TIME FOR (1) PC. (ITEM 10)			.12
INSPECTION (ITEM 11)			1.92
TOTAL JOB CHANGE ELEMENTS			4.66

DRILL - REAM - CT'R BORE — TABLE IV

DRILL SIZE				BRASS & ALUM. 300 S.F./M.			EV.&NAV.&C.R.S. 100 S.F./M.			STL'S 70 S.F./M.	
DIA.	NO/L.	FRAC	D.P. IN *	R.P.M.	TIME BR.	TIME AL.	R.P.M.	TIME EV.NA.	TIME C.R.S.	R.P.M.	TIME ST'S.
.040	60		.014	3800	.178	.228	3800	.187	.345	3800	.479
.047	56	3/64	.016		.156	.182		.160	.275		.378
.063	52	1/16	.021		.130	.141		.132	.203		.294
.078	47	5/64	.026		.110	.116		.115	.162	2370	.232
.094	42	3/32	.032		.092	.098		.101	.134		.188
.109	36	7/64	.037		.076	.085		.092	.115		.153
.125	30	1/8	.042		.064	.078	2370	.083	.102	1800	.144
.141	28	9/64	.052		.057	.073		.078	.093		.137
.156	22	5/32	.058		.052	.070		.073	.088	1590	.134
.172	17	11/64	.063		.048	.068	1800	.072	.087		.134
.188	12	3/16	.068		.046	.067		.073	.088	1200	.137
.203	6	13/64	.073		.044	.066		.077	.092		.140
.219	2	7/32	.078		.043	.067	1690	.082	.100		.150
.234	A	15/64	.084		.044	.067		.087	.110		.163
.250	E	1/4	.094		.045	.068	1200	.094	.122	790	.183
.281	K	9/32	.105		.046	.068		.102	.133		.203
.313	O	5/16	.115		.049	.069		.112	.147		.224
.344	S	11/32	.125	2370	.052	.069	790	.121	.161	490	.251
.375	V	3/8	.147		.056	.070		.134	.178		.287
.438		7/16	.167		.060	.071		.148	.200		.325
.500		1/2	.188		.063	.072		.165	.230		.366

OPERATION FACTORS			
REAM	.12	COUNTERBORE	2.00
***RE-REAM	.12	SPOTFACE	1.25
COUNTERSINK	1.00		

TOOL RELIEF FOR CLEARING CHIPS

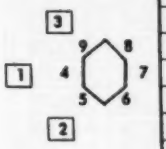
DRILL - (DEPTH ÷ DIA – 4)

COUNTERBORE - (DEPTH ÷ ¼ DIA. – 2)

INSPECTION ELEMENTS	TIME	OCC.	TOTAL MIN.
11) INSPECT FIRST PIECE			
WALK TO-INSP.-WAIT-RETURN	XXX	XXX	.97
LOCATE TOOLS			
THREAD GAGE	.50		
PLUG GAGE	.15		
INDICATOR	.10		
MIKE	.10	1	.10
INSPECTION PROCEDURE			
THREAD GAGE	.25		
PLUG GAGE	.10		
SCALE DEPTH OR LENGTH	.35	1	.35
MIKE DEPTH	.45		
MIKE DIMENSIONS	.50	1	.50
INDICATE DIMENSIONS	1.92		
CONCENTRICITY	.35		
COMPARATOR	3.00		
MISC.			
TOTAL INSPECTION			1.92
			11.92
TOTAL MIN. FOR SETUP PROCEDURE			13.84
CONVERSION FACTOR			.021
STANDARD HRS. PER SETUP			.29
STANDARD HRS. PER JOB CHANGE			.10

OPERATION NUMBER 40 **LATHE SETUP & DETAIL CARD** PART NUMBER AA-7342

DATE 11-9-56



	TOOL	TOOL SIZE	TOOL LOC. & NO.	T. STL.	SPD.	FD.	CL.
1.	Collet	1/8"	Mach.				
2.							
3.							
4.	Knurling Tool & Extension		Lc.500		3500	HD	
5.							
X	Collet stop (Hard)		Lc.500				
7.							
8.							
9.							

MISCELLANEOUS ELEMENTS	FREQ.
1. FILE BURRS	
2. CLEAN PART – CLOSE DIM. ONLY	
3. PLACE PC. IN COLLET	
4. PLACE PC. ON ADAPTOR	
5. PRESS PC. ON MANDREL	
6. PLACE PC. IN FIXTURE	
7. PLACE PC. IN CHUCK	
8. STACK PC. IN SKID	
9. PLACE PC. IN PAN	1
10. PLACE PARTS ON SPDL.	
11.	
12.	

COOLANT	SYM.
SOLUBLE OIL	SO
CUTTING OIL	CO
JOHNSON WAX & WATER	JW

INSPECTION	FREQ.	INSPECTION	FREQ.
PLUG GAGE		DEPTH	
CONCENTRICITY			
LENGTH			
O.D.	1/25		

SKETCH & REMARKS

Mike needed 0-1"

Machine running continuously

(Figure 2 c)

COPY

FORM NO. 884

OPERATION SEQUENCE

1. Place part in collet
2. Move piece to stop
3. Close Collet
4. Index Tool into Pos.
5. Advance Knurling Tool
6. Knurl
7. Return Knurling Tool
8. Index out of position
9. Open Collet
10. Move piece out
11. Remove from collet
12. Dispose of part

(Figure 2 d)

DEVELOPING STANDARD DATA FOR CLERICAL OPERATIONS

by
J. L. Morrissey
A. T. Kearney and Company

I - LATE DEVELOPMENT OF OFFICE STANDARDS

Although there have been a number of companies which have been active in the office standards field for several years, the development of this type of standard has lagged far behind standards developed for the shop. There are several obvious reasons for this lag. Probably the most significant is the fact that setting standards on office operations is a considerably more difficult job. This type of standard falls into the same category as maintenance and repair standards, and it is only natural that Standards Engineers would do the factory work first with the expectation of quicker return for their effort.

Another reason for the lag in setting standards for office work is what we might call the white collar resistance to standards. Since setting standards for clerical workers would place them on essentially the same plane as shop workers, it is the attitude of many concerns that this type of a program would lower the prestige of their clerical employees. Couple this attitude with the fact that many office managers and financial people feel a natural resistence to having Industrial Engineers analyze their operations, and you will understand why progress has been slow.

Along these same lines it was also feared that setting standards for clerical workers might invite unions to become more active in this field. However, numerous instances can be pointed out where office workers are working under some type of a clerical standard and, to date, there has been no serious threat of unionization.

II - TYPES OF STANDARDS

Many office managers and supervisors feel that they do have standards for their employees. These standards, in many instances, are based on past history covering the same or similar jobs. In most cases, when these standards are examined in the light of a more accurate type of data, it is found that supervisory developed standards for office workers are about as inaccurate as standards developed by supervisors in the shop.

In some offices, an adjustment of historical standards has been made wherein the supervisor has taken his historical experience and tempered it with his judgment. Where these estimated standards have been developed on a rational basis, they do serve a useful purpose. However, too often these estimated standards are a result of an economy drive during which an attempt was made to cut office costs and inaccuracies and inconsistencies are carried forward to the new base.

In some companies, work standards for clerical employees have been developed with direct time study observation. Because of the resistance to stop watch observations in an office environment, this technique is difficult and not very widespread. An additional difficulty is encountered because of the large variety of office operations which make setting standards by time study relatively costly. On the same basis, taking direct observation MTM studies on the individual operations encountered in the office environment can also be costly and may generate resistance similar to that experienced with stop watch time study.

One direct observation method by which time standards can be set is through the use of the work sampling technique. When using this procedure, total counts are recorded and operations are not only observed but may be leveled to increase the accuracy. From this information elapsed times can be determined and modified, as required, by the leveling factor. Unit output can then be calculated on the basis of the work output observed during the work sampling period.

At the current stage of development in the office standards field, probably the most economical and satisfactory measurement system is one in which basic data is used for determining the bulk of the standards. If basic office standard data are properly developed, they can be used in a variety of situations at a moderate cost when compared to individual standards set by direct observation.

Because of these and other factors, A. T. Kearney and Company has developed a manual of basic standards for clerical operations which can be used in most office operations.

III - ADVANTAGES OF BASIC DATA DEVELOPED WITH MTM

Except for machine operations, virtually all of the data in the A. T. Kearney Manual was developed through the use of MTM. By using MTM, it was possible to develop a manual of basic times which was more flexible than the usual type of basic data obtainable with time study. The form of the final data is not only flexible, but easy to use. This last feature is especially important when dealing with relatively untrained office standards personnel or systems and procedures analysts.

Another advantage derived from using MTM instead of time study for the development of standards for manual work is that the net cost of developing the data was much less. Because of the variety of conditions that may be encountered in office work, many hundreds of time studies would often be necessary before an acceptable average time value could be determined for an operation, and, as in shop work, methods analysis can be more easily accomplished. MTM permits the statement of reasonable motion patterns which can be set up and tried by experienced office workers. If the methods, synthesized before any observation, was found to be satisfactory, a time standard could then be developed for what was considered a reasonable method of doing the operation. In this way, no time was lost in observing ineffective methods.

Another advantage of using MTM lies in its adaptability to situations where variations may occur when doing the same operation. An example is the determination of an accurate time standard for removing a document from a file in which the items are not placed in any alphabetical or numerical sequence. When problems of this nature and similar ones were encountered, the time was established for the basic motion pattern and then the probability of the number of times that the motion pattern would be repeated was computed on a theoretical or mathematical basis. By multiplying the basic time to perform a set motion pattern by the probable number of times it would occur under average conditions, it was possible to arrive at average time for what could be a complex time study problem.

I mentioned that the use of MTM led to the development of standard data that is easy to apply. The exhibit on Pages 31-2-3 shows how a table of values was developed for picking up and moving objects at the normal office work place.

It is not intended that these elemental standards would be used in their raw form. The standards are accurate and specific enough so that they can be used in developing operational standards for a repetitive office operation such as billing or machine accounting operations. On the other hand, the elemental standards shown in the exhibit on Pages 25-6-7 can be grouped together to represent average conditions and operational standards which can be used to measure a variety of less highly repetitive operations throughout an office. Standard output may be measured by simply multiplying the average time value by a frequency factor based on observation at the various work stations.

Thus it may be determined that for general office use at the work area, the average combined reach and move distance is 24", and the average grasp conditions are exemplified in element 1B in the exhibit on Page 28. Therefore, the average time to move an object about the work area would be 33 TMU, or 20 KU.

The exhibit on Page 28 shows the final standard developed from the elemental values presented in the exhibit on Pages 25-6-7. It will be noted in the exhibit on Page 28 that there are two time columns, one the standard TMU column and the other the KU, or Kearney Unit column. This second column is used to give flexibility to the data and is the equivalent of TMU time stated in thousands of a minute, thus under element number 1A, 2 TMU is equal to .001 minutes.

IV - THE CLERICAL CONTROL PROGRAM

Before any book of basic data can be used, certain preliminary work must be done in the department where the standards will be applied. This preliminary work in office istuations is much the same as is encountered in unmeasured shops where it is decided to start a standards program.

First, a simple outline of each of the various jobs performed in the department or group to be studied is made. Whenever possible, this basic outline is limited to five to seven steps. From this outline, plus some additional information obtained from the supervisory personnel, the jobs are separated into two categories, those which appear to be acceptable from a methods standpoint and those which appear to offer possibility for savings through systems and procedures work.

The jobs showing possibilities for improvement are then analyzed. This analysis may be done on a departmental or company-wide basis. After the work has been simplified and standardized, the work content of all the jobs or operations is recorded. Usually this is best done by interviews with the employees performing the work.

The work is then described in some type of a flow process chart which best fits the local condition.

From flow process charts, work element lists are made and standard times from the manual are applied to the elements making up the job being performed. To determine basic time values for all possible elements which could occur in normal office work is an enormous job which would be very costly. The manual of standard times, as developed by A. T. Kearney and Company, makes no attempt to cover all possible jobs which could be encountered in an office situation. Rather, a great deal of time and effort was spent in setting standards for those jobs which are quite common and represent the bulk of the work encountered in the office.

In most situations, a relatively small number of actual jobs account for 80% to 90% of the time of the worker or group of workers being analyzed. As a means of measuring the remaining 10% to 20%, a system of work sampling is used. For the work sampling study, the work is usually divided into the following categories:

1. The major job being performed.
2. The work incidental to the major job.
3. Miscellaneous work performed through the day.
4. The delay factors beyond the control of the employees.
5. Avoidable delays.
6. Personal time.

Using the information obtained from the work sampling study, it is possible to break the day down into the various portions outlined above. Some of these items will be functions of the day and other functions of the job performed. On this basis, a ratio can be made to show proportions between major work and incidental work. Assuming that the major work and the incidental work are performed at the same pace, the amount of standard time necessary to perform incidental work is obtained by multiplying the major work time by the percentage determined from the work sampling study.

As an example, if we consider a simple typing operation, we might find that 80% of the time spent typing falls into the category which we classify as major work and for which we have set up standards, while 20% of the time is spent in work incidental to the typing. In this case, incidental work is defined as that type of work which maintains a steady ratio or proportion to the major work. On this basis, then, we can say that for every one hundred minutes of total typing work, 80 standard minutes can be set up from the work standards and 20 minutes will be needed for the incidental work.

Using this system then, standards are set on the major portion of the work and, from the ratios determined by the work sampling study, allowances are added to the standard times for incidental work. Similarly, those jobs which become a function of the day can be given daily allowances on the basis of the work sampling studies taken. This procedure makes it possible to cover a large number of work situations with a relatively small table of standard values for clerical operations.

After the standard has been set for each of the operations being considered, it is necessary only to multiply this standard time by the volume of work which will be encountered for the period being considered. In many office installations, a determination of the volume of work flowing through a department or a group is best done by using a statistical sampling plan which gives some predetermined level of accuracy.

The exhibit on Page 29 shows in simplified form how the results of the work sampling study is used in conjunction with the basic data to set standard time on a typing operation. The column headed "Observed % of the Day" is from the work sampling study.

V - COMPARATIVE ACCURACY

Since it is generally conceded that it might be dangerous to lift standards from one work environment and place them into another, a question of the accuracy of this type of general basic standards naturally arises. In determining relative accuracies, several factors should be considered.

When setting normal standards for an MTM situation in the shop, we are usually considering the daily performance of one individual or a relatively small group of individuals. Under this set of conditions, the industrial engineer attempts to set standards which will meet a plus or minus 5% accuracy test for each standard set.

The situation in offices is usually somewhat different. In the first place, the average or bulked standards developed from a manual of times as shown in the exhibit on Page 28 would be used in a non-incentive situation. Secondly,

standards for office work, as we use them, are set up for groups of people comprising an entire department of sub-sections of a department. Thirdly, the period of time considered is usually one month rather than the period of one day used in shop installations. On this basis then, the office standards developed from a set of basic data values are in the same realm of percentage accuracy as normal shop standards set from direct observation are to custom tailored basic data.

Although it is not recommended that these standards, in their averaged form, be used for setting individual incentive rates, this does not preclude the use of the standards for checking output of one operator against another.

To guarantee that the accuracy level remains constant, precautions are taken similar to those in the shop so that all work is audited from the methods standpoint, and an accurate recount of output is obtained. With these precautions, it is possible to set and administer a measurement program for office standards which will provide controls comparable to those obtained as a result of a standards program in a shop operation.

TABLE 7

MTM STANDARD ELEMENT FILE ELEM 1

ELEMENT DESCRIPTION GRASP OBJECT DATE 11/1/57

ANALYST J.H.

MATERIALS, TOOLS, EQUIP. ETC.

Sheet 1 of 3

DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT

Element Begins at End of Reach to Object and Ends with Grasp Completed

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
A. EASY TO GRASP OBJECT SUCH AS BOX OF PAPER CLIPS, DATE STAMPER						
			2.0	G1A		OBTAIN CONTROL
			2.0	(0.0012)		
B. MEDIUM DIFFICULT OBJECT SUCH AS BOOK, TRAY OR HEAVY OBJECT						
			2.0	G1A		
			5.6	G2		
			7.6	(0.0046)		
C. SMALL OBJECT JUMBLED WITH OTHER OBJECTS SUCH AS PAPER CLIP IN BOWL, THUMB TACK, ETC.						
			9.1	G4B		GRASP
			9.1	(0.0055)		
D. SINGLE SHEET OF PAPER FROM TOP OF DESK.						
			3.5	G1B		OBTAIN CONTROL
			3.5	(0.0021)		
E. SINGLE SHEET OF PAPER FROM TOP OF PILE.						
			3.5	G1B		P.U.
			5.6	G2		OBTAIN CONTROL
			9.1	(0.0055)		

TABLE 7

MTM STANDARD ELEMENT FILE ELEM 1

ELEMENT DESCRIPTION GRASP OBJECT DATE 11/1/56

ANALYST J.H.

MATERIALS, TOOLS, EQUIP. ETC.

Sheet 2 of 3

DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT

See Page 1

DESCRIPTION - LEFT HAND	F	MOTION	TM	MOTION	F	DESCRIPTION - RIGHT HAND
F. GROUP OF PAPERS FROM TOP OF DESK						
			0.0	G5		CONTACT EDGES & TOP
			2.9	M1B		LIFT STACK
			11.2	G2	2	GET ALL & GAIN CONTROL
			14.1	(0.0085)		
G. GROUP OF PAPERS FROM TOP OF PILE - ANY NUMBER OF SHEETS.						
			0.0	G5		CONTACT EDGES
			2.9	M1B		LIFT STACK
			5.6	G2		GAIN CONTROL
			8.5	(0.0051)		
H. ENVELOPE BY ITSELF LYING FLAT.						
			3.5	G1B		GRASP
			3.5	(0.0021)		
I. ENVELOPE ON TOP OF PILE, LYING FLAT, OR GROUP OF ENVELOPES ALONE.						
			3.5	G1B		GRASP
			5.6	G2		GAIN CONTROL
			9.1	(0.0055)		

TABLE 7

MTM STANDARD ELEMENT

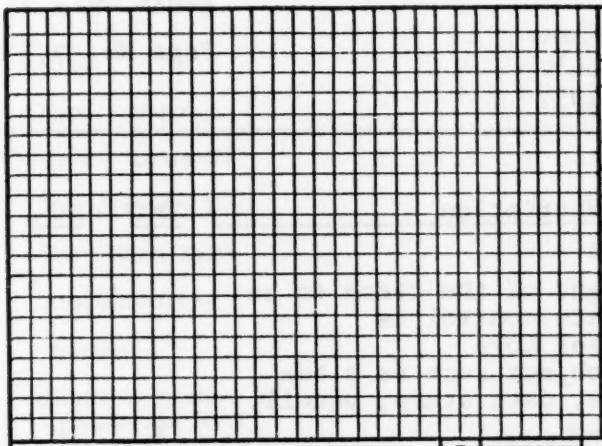
FILE: ELEM 2

ELEMENT DESCRIPTION: REACH TO OBJECT(S) & MOVE

DATE: 11/1/56

ANALYST: J.H.

MATERIALS, TOOLS, EQUIP. ETC.:



DESCRIPTION OF WORKPLACE:

APPLICATION OF ELEMENT:

A. Reach to Single Object - Move to Approximate Area.

B. Reach to Object Jumbled with Others and Move to Exact Location.

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
A. SINGLE OBJECT		SEE	BELOW	R-B		TO OBJECT
				M-B		TO AREA
B. OBJECT JUMBLED		SEE	BELOW	R-C		TO OBJECT
				M-C		TO AREA

Over	Inc.	Total	In.	R-B	M-B	Total		R-C	M-C	Total
0	4	2	1	2.5	2.9	5.4		3.6	3.4	7.0
4	8	6	3	5.3	5.7	11.0		7.3	6.7	14.0
8	12	10	5	7.8	8.0	15.8		9.4	9.2	18.6
12	16	14	7	9.3	9.7	19.0		10.8	11.1	21.9
16	20	18	9	10.8	11.5	22.3		12.2	12.9	25.1
20	24	22	11	12.2	12.8	25.0		13.6	14.4	28.0
24	28	26	13	13.7	14.0	27.7		14.9	16.1	31.0
28	32	30	15	15.1	15.2	30.3		16.3	17.8	34.1
32	36	34	17	16.5	16.4	32.9		17.7	20.0	37.7
36	40	38	19	17.9	17.6	35.5		19.1	21.2	40.3
40	44	42	21	19.4	18.8	38.2		20.5	23.0	43.5
44	48	46	23	20.8	20.0	40.8		21.8	24.6	46.4
48	52	50	25	22.2	21.2	43.4		23.2	26.4	49.6

CLERICAL WORK STANDARDS

MOVE PAPER AND OTHER OBJECTS ON DESK

Issue No. 1 Date: November 1, 1957

Element Number	Elemental Description	TMU	KU
1.	GRASP OBJECT Element begins at the end of the reach to an object and ends after complete control is achieved prior to beginning of move.		
	A. Easily grasped object such as a box of paper clips, date stamp, pencil, etc.	2	1
	B. Medium difficult object to grasp, such as a book, tray or heavy object	8	5
	C. Small object jumbled with other objects such as a paper clip in a bowl, thumb tack, etc.	9	6
	D. Single sheet of paper from top of desk	4	2
	E. Single sheet of paper from top of pile	9	6
	F. Group of papers from top of desk	14	8
	G. Group of papers from top of pile	8	5
	H. Single envelope on top of desk	4	2
	I. Envelope or group of envelopes alone, in cart or in a pile	9	5

2. MOVE OBJECT TO DIFFERENT LOCATION

Reach for object and move to new location or move object and return hand to normal work area. Object may be on desk or in drawer. Time for grasping, opening drawer, etc. is not included.

Total Combined Distance		Reach To: Single Object or Stack Move To: Approximate Location		Reach To: Jumbled Objects Move To: Exact Location	
Over	Including	TMU	KU	TMU	KU
0	4	5	3	7	4
4	8	11	7	14	8
8	12	16	10	19	11
12	16	19	11	22	13
16	20	22	13	25	15
20	24	25	15	28	17
24	28	28	17	31	19
28	32	30	18	34	20
32	36	33	19	38	23
36	40	36	21	40	24
40	44	38	23	44	26
44	48	41	24	46	28
48	52	43	26	50	30

CONDENSED WORK LOAD ANALYSIS

Class	Observed % of the Day	*Observed Equivalent Minutes Per Day	Std. Mins. Per Day
Type - Major	60	288	259
Type - Incidental	12	58	52
Miscellaneous Work	10	48	43
Unavoidable Delay	5	24	24
Avoidable Delay	8	38	0
Personal	5	24	24
Available Reserve for Additional Work	-	-	78
Total	100	480	480

1. Ratio of Incidental to Major = $\frac{12}{60}$ = .2

2. Standard Time for Major work = 259 minutes (from basic data)

3. Standard Time for Incidental work = .2 x 259 = 52 minutes

4. Apparent efficiency for Major work = $\frac{259}{288}$ = 90%

5. Standard Time for Miscellaneous work = 48 x .9 = 43 minutes

*Obtained by multiplying each of the observed % of the day figures by 480.

THE USE OF MTM IN METHODS DEVELOPMENT

by
Lucille Gill
Kent Fabrics Co.

It is certainly presumptuous of me to be up here talking to a group of this caliber about anything, much less methods improvement--so before I go any further let me say that I can only tell you what we have done and, by some weird chance, hope that it may be of some interest to you.

MTM has been such a godsend to us, and we have used it to solve many problems, but in our particular case methods improvement has been one of the greatest of the godsends.

Competition, as you well know, never stops breathing down the necks of everyone in the sewing business. Every time another competitor moves to the southland or Puerto Rico, the boss starts getting jittery--and certainly not without reason. There is just no room price-wise, if you operate in the great industrial state of Michigan, for any unnecessary cost. It isn't only the excess direct labor cost, but, in our case, it is the 28 cents per hour for fringe benefits too. Every time we can do a job with one less person, we save six hundred dollars, plus the continuing cost of the labor and fringe benefits.

Methods improvement is the only way we stay in business profitably and nay can say that that isn't important.

How much can be saved by improving methods depends on what you start with, but the fact remains that to some extent there is no end to it. Many times we have thought that a certain department was set, only to discover by a detailed analysis that there was still room for improvement. Sometimes this improvement comes from the operators themselves and usually from an alert operator who has worked about six months and still is striving to improve her earnings. It just about never comes from older operators and, of course, not from the new ones.

Our chief mechanic has been of tremendous help in developing folders and guides to ease the work through and, in some cases, to combine two operations into one.

A good alert supervisor can also be a source of help in handling, especially as regards to "get and dispose" of work and some dandy and usually very workable ideas come from this source.

These people have had only 12 hours general instruction in MTM. In retrospect, this is not enough. Our next program for instruction will be 25 to 30 hours at least.

I suppose what I am trying to say here is that the analyst must be on the best of terms with everybody in the factory and they must be on his team, always on the lookout for ways and means to improve handling. Then, of course, the analyst has his own ideas for improvement that people on the job have been looking at for years and never saw.

Briefly then, the ideas for methods improvement in our factory come from the operators, the chief mechanic, the supervisors, factory manager, and last but certainly not least, from the MTM analyst. Probably 90% come from the analyst, but the other 10% are important too.

After the idea for method improvement has been kicked around a bit and the analyst comes up with the amount of money to be saved, a decision has to be made as to how and when it should be put into effect. Woe be unto anyone who attempts to make any changes in our factory during a high seasonal production schedule. I have learned the hard way that changes of any moment are best made during slow periods, even though a substantial saving is dangling before your eyes. If it in any way will hold up the production line --leave it alone, brother--until such time as it can be put into effect without hindering shipments. Many times, of course, it is possible to make arrangements in advance or maybe the change is minor, but, generally speaking, we make changes only during normal or slow periods.

Supported earnings are always a bone of contention when any change takes place and we have had our share of contention. For our purposes today we will speak only of supported earnings as it applies to methods improvement.

No change is too small for us to make, but when we make a change in an established operation that results in the piece work rate being adjusted either up or down by 5%, we support the operator's earnings at 100% for 40 hours. After 40 hours, it is supported only to the one dollar minimum. We do not say that 40 hours will always be sufficient for the operator to adjust to a radical change, but we do say that they

have a good reason to make an effort to do it and that, in any event, it takes the curse off the change.

Two advantages accrue to the company from this policy; one, it is easier to implement the change and, two, the company has a time limit on the support. One disadvantage is obvious; it costs more at the time than if earnings were not supported, but that is debatable from the long-range viewpoint. When we make changes of less than 5%, we do not support earnings.

Occasionally we run into a stone wall when we change a method or machine on an operator who has been doing another job, or the same job using a different method for several or sometimes many years. You can write specifications in print 3 feet high but to her it is just paper work and since she knows how to sew better than you do, proceeds to develop her own method. One of two things happens; if she's a rate beater, she might beat it by as much as 30% over what the projected earnings are for the job. I've seen, and I know you have, operators easily do simultaneous motions that the book says are difficult. Couple that with a highly repetitive operation and that rate is beat right now and by a lot more than you want to see.

There seems to be three schools of thought on what to do about it, when the method change comes from the operator. One is to change the specifications and rate to conform to the operator's method, one is to have a bonus for good suggestions, and the other is to let it ride. We, at the moment, are for the most part letting these ride because, first of all, we have very little of it and we believe that a few good pace-setters provide a healthy atmosphere, and also provide the general feeling, we hope, that an operator can go all out without the thought that she herself will reduce her own rate. However, this can be dynamite and we are watching it closely. If we have pulled a boner, we have no hesitancy in correcting it quickly, but mostly its the fine line of whether or not the method the operator developed is one that could be generally used in our factory. Mostly, we stick to our original analysis based on the data card and let it go. We do not use the "difficult" simultaneous motions in our analysis. We know there are both advantages and disadvantages and, frankly, we are somewhat on the fence.

Our procedure is the same for changing a line or operation for established items as it is for new items and this is generally the procedure we follow:

1. The item is broken down into operations.
2. An analysis is made of each operation.
3. Number of dozen per week is estimated.
4. Type and number of machines required.
5. Number of operators required.
6. Standard allowed hours and rates set.

At this point, the item has been costed and the operation list is turned over to the factory manager who proceeds with dollies to set up the production line on paper. When this is set, the "get and dispose of work" and probably a few other extra curricular activities are added to or in some cases subtracted from the analysis.

At this point we pretty much know just how everything will be handled, or so we think. On established items with an established market the procedure works fine and changes are usually minor. On new items, however, the whole procedure can at best be a guide.

First, the production schedule is an educated guess and it is here that it is an absolute must to keep on top of methods. At 1,000 dozen per week, the handling is one matter; at 250 dozen per week it will be another, or the projected estimates may be a poor increment for line production. These are the cases where methods can drastically change in the factory and unless the analyst is on top of the situation, rates can become very "cock-eyed." Methods changes and corresponding rate changes can come fast in these situations. It is here that MTM has been of great value. Without an analysis and the accompaning job descriptions, I do not know how we could possibly keep abreast of these changes.

When we are at the point of actually starting production on the new line for an established product, or a new product, specification sheets, Figure 1, are written and pasted at each machine.

These specifications are taken directly from the analysis (Figure 3), but written in very simple form. It is from these sheets that the operators are trained for the job. It is these sheets that experienced operators hate and new operators like very much. But the fact remains that that is the method that is paid for, and operators using more elaborate movements than are necessary soon learn that it doesn't pay.

Job descriptions in our factory are used for training new operators and for retraining experienced operators on new jobs.

This is the way we do it. The instructor sits down at the machine with the operator also seated,

on her right. The job description is between them so both can read it.

They start at the top with the name and style number of the item and with a sample of the finished product, go over the item and show the operator where her operation fits into the completed garment, and what her operation number is so she will know which piece work ticket to remove. Then she is shown where the supply of thread for her operation is kept and how to check to be sure she is using the right kind.

We do very little or nothing at this point with RPM's or machine class, but we do point out that stitches per inch are important because when we get through the outside stitches must all be the same size on the garment and also that the rate is set on the basis of that many stitches per inch.

The instructor proceeds to do the operation, reading one line, doing what it says, and proceeding to the end.

The trainee then sits at the machine and does the same thing, over and over, doing only one line of the job description at a time. Gradually this is increased to two, three, four, etc. until she can do it without looking at the description. The instructor is with the trainee until she can go through one line at a time properly and then checks back only to see that no deviations are developing. Gradually then we begin to progress and rhythm develops. It is here that there is the most danger of deviations and the operator's inventiveness starts to show, so it is at this point on about the second or third day that the instructor has to be on her toes.

The job description stays at the machine as long as the operation is done because it is also used by quality control for checking stitches and workmanship.

We have also developed a policy on methods and rates for new items only that has been helpful many times. For 30 days after an operation is started, the method and rate is temporary. During and up to 30 days, we make whatever changes in handling that we can see to improve the handling or flow of work. After 30 days we support earnings when changes are made.

At least this gives the analyst an opportunity to see what is happening. Having done a lot of analysis work, particularly on new products, I know that the educated guesses on sales can be 100% right or 1000% wrong and I also know that for any one of many reasons changes must be made after getting under way. Those 30 days help a lot.

For instance, our head mechanic has come up with some splendid folders after he sees the operations, even though he has actually done, or supervised, the setting up of the original machines. We never indicate in a case of this nature why the idea wasn't brought up before because this would, in time, only result in not expressing ideas for improvement.

I know what many of you are thinking--the analyst should foresee all. However, in our experience, whether we are lazy or just human, I hesitate to say but I do know that when, for instance, production schedules change, methods change automatically follows. I also know that for new products there are many methods improvements after the line starts production. These changes are 100% in handling, but since handling requires about 70% of our work, it is important.

I do not believe that it is too much of a reflection on the analyst if changes are made after production starts, but it is a reflection if the changes are not made. It is MTM that provides the information which makes possible the recognition of these changes.

This, then, outlines the procedure we use, which I present not as a glowing example, but only as a system that we have worked out. As we increase our manpower on MTM, we will do a more thorough job.

Before finishing, let me say that we manufacture infants' wear and employ 225 people, about 40 of whom work on a second shift. About 65% of our business is with minor improvements in construction, standard year in and year out. The other 35% consists of style items that change twice a year.

STANDARD DATA IN THE SEWING ROOM

by
E. J. Smith
A. T. Kearney and Company

Over a period of years many of us here have applied various Industrial Engineering techniques and principles to the problems of product improvement and cost reduction. Some of the ways and means used successfully include:

Time Study
Motion Study Using Motion Pictures
Flow Charts
Lists of Guide Questions
Work Simplification Principles
Layout Improvements
Machine Attachments and "Gadgets" at the Work Place
Improve Operator Training
Incentive Pay Systems
Better Quality Control
Work Sampling
Others which many of you could mention after a little attention to the list

Any of these techniques could be thought of as "tools" in the kit of the Industrial Engineer. Like tools in any kit, each of these, to be most effective, must be used in the proper place and in the correct manner. When so used, any of these "tools" will be quite useful in attacking the problem of cost reduction.

We are here today to discuss the use of another tool in the kit of the Industrial Engineer. Methods-Time-Measurement, or MTM, is a motion study technique which has been available less than 10 years. In this time, the technique has come to be widely accepted and used in many industries in addition to the Sewing Industry.

We are enthusiastic about the use of this technique. In our enthusiasm we are sometimes inclined to give others the impression that other techniques are now obsolete and all we have to do to solve our problems is to enroll in a course of MTM. Because there has been a tendency to obscure the real nature of the technique, it might be well to examine briefly what MTM is and some of the things which it is not.

In the first place, MTM is not a "cure-all" for your troubles. It will not give you any benefits; it will not solve all your problems. I am sure none of us ever thought that time studies, or movies, or flow charts, or any of the other techniques would do this, even though they are often very useful and helpful. Yet occasionally we read or hear that MTM will do wonderful things for us, such as:

Reduce Grievances
Reduce Labor Turnover
Spot All Errors in Present Methods
Determine Best Methods

Perhaps we are "splitting hairs" in mentioning this aspect of the subject, but it seems that instead of making claims for what MTM will give us, we should emphasize that MTM is an additional tool in the kit of the Industrial Engineer, and that the engineer has to work at using this tool. MTM has certain characteristics which make it a valuable aid in helping us develop answers to some of our shop problems but the use of MTM will not make the other techniques obsolete.

Let us list a few of the unique characteristics of the MTM technique and then later see how these characteristics make the technique valuable. Three of the more helpful characteristics evident in the application of the technique are these:

1. It requires a thorough and detailed analysis of the operation studied.

2. It provides the means for an exact, detailed, yet brief description of method.

3. It provides accepted time values for each motion used in the method analyzed.

In our opinion, these characteristics are the ones which make the MTM technique helpful. You will, I am sure, recognize from these characteristics that the technique is one for getting and recording information. How well you get it, and what you do with the information after you get it, will determine how valuable the technique will be to you. In this respect it is like time study. Time study is also a technique for gathering information and, again, how well you get the information, and what use you make of it determines how valuable the time study technique will be to you.

The specific topic we wish to discuss today is the use of MTM in the development of standard data for sewing operations. In order to point out the unusual advantages of using the MTM

technique for developing such data, let us first consider various aspects of standard data as it may be used in the sewing room.

First, what is "standard data?" As we are using it in this discussion, standard data will consist of the times required for an operator to perform various operations. This time will be the time required to perform these operations at a pace which we expect her to work to earn her base rate. With such information available, we can draw from the time values rather than make a new study on each new job. Such data will usually consist of the standard time to perform various small parts, or "elements," of a job. As you know, a time study element is a small portion of a job which can be easily timed, as "Get Work to Needle," "Dispose Part," etc. These elements of a job will usually be interchangeable between different jobs, so that the proper combination of elements will give us a complete list of elements required to perform any job covered by the data. The standard time for each necessary element can be added to determine the total standard time for the job in question.

Now obviously the time required to perform the same element of work on different sizes of garments may not be the same. For example, if the length of seam on a large garment is longer than the length of the same seam on a small garment, it is quite likely that the longer seam will require the longer time to complete. The time value for such variable elements will usually depend on some physical characteristic of the part, such as size, type of material, inches of measurement, etc. Other elements of the job may require the same time to perform regardless of the size of the garment.

Therefore, in our set of data we will have some elements which require a changeable, or variable, time to perform. This type of element is called a "variable element." For example, to sew a short seam may require less time than to sew a long seam. We will have other elements which require the same or constant time to perform. This type is called a "constant element." To change a bobbin on a certain type machine should require about the same amount of time whenever it is changed.

Second, what advantages might we expect to gain from the use of standard data? Some of the more evident advantages could be mentioned briefly:

1. Rates will be more consistent from job to job, since all rates will be set from the same set of elemental times.

2. Rates can be set faster with data as compared to making complete studies on each job. Time required to develop the data will usually be more than made up by the reduction in time required to set new rates.

3. Rates can be set in advance of production on new work if we know how the work is to to be done:

   (a) This makes it practical to set rates on low production items which might not otherwise be covered by rates.

   (b) Setting rates in advance also makes it possible to estimate accurately the cost of new work.

Standard data can be developed with time study. Such data have been quite common in hard goods industries for many years. Standard data developed with time study have also been used in the sewing industry for many years and the three advantages just mentioned will apply to data set with time study as well as to data set with MTM.

In our consideration of the various aspects of standard data, let us consider, third, some features of sewing data set with time study.

Time study data can be divided roughly into four types. Perhaps there are other types but these four are common and come readily to mind. How many of these four types you can use will depend upon the range of styles and sizes that you make. All four of these types have been used in a shop making a wide range of styles and sizes of boys' and young men's slacks.

First is the "standard operation" type of element which occurs on many jobs. This might be "change bundle of work," "change bobbin," or "clip coupon." The variables might be size of bundle, type of bobbin, or some other obvious variable. This type of element would be applied on the basis of the number of garments or pieces sewed for each occurrence of the element. This is a very simple type of data and the obvious advantage is that we can apply these values without having to time study the operation for each rate. We need only to determine how often it occurs for each part sewed.

The second type of data set with time study will apply to the same operation on a variety of styles. In this instance, we group the styles of the part by various characteristics and then develop a standard for each group. To apply a rate to a new part, we have only to classify it properly and apply the rate for that classification. In the manufacture of slacks, one operation is

"make fly." In making flys for slacks, we might notice variable such as "with lining" or "no lining," length "over" a certain number of inches of length "under" a certain number of inches, "with stops" or "without stops." With rates developed for each combination of variables, we could readily apply the correct rate to a new model.

The third type of time study data is the type usually thought of when we discuss standard data. This type consists of time values for a variety of elements where some, or all, of the elements may be variable. This data is applied by first listing each element required to perform the job and, second, using the proper time value for each element as may be indicated by length of stitching, size of the part, or some physical characteristic.

One example of such data is found in serging or over-edging the "fronts" or "backs" of slacks. These pieces form the legs of the trousers and require a total of over 200 inches of stitching per pair on some models. Length of stitching is, of course, the main variable. Use of other elements depend upon whether the particular style requires, or does not require, that element.

Another example of this same type of data can be found in the pressing of slacks, where the main variables are size of garment and type of material in the garment. In this example we would need measurements of the finished garment such as length of inseam, length of waistband, and other characteristics such as type of material in the garment, and presence or absence of pleats. In this instance, an element may or may not occur on a particular garment. When it does occur, it may be either constant or variable. When it is a variable, the value will depend on some physical characteristic of the garment. Rates set with this type data require observation or visualization of the operation and then selection of the proper value for each element. Such a rate is more easily and more quickly set with data than with a separate time study and all the advantages claimed for standard data will apply to this situation.

Now these three types of data have one important thing in common. Each variable depends for its time value on some physical characteristic of the material or part being handled. The physical characteristic may be inches of stitching, size of part, type of material such as wool, cotton, nylon, etc. This same approach is used in hard goods industries where data is set with time studies, and where variables may be weight, a dimension, or one or more of any number of variables. In fact, we may safely say that variables included in standard data set with time study will usually depend for their value on some physical characteristic of the part being handled.

These three types of time study data we have discussed are quite useful, in that they give us the three advantages of standard data previously mentioned of:

1. More consistent rates,
2. Rates set more quickly, and
3. Rates set in advance of production.

The time study technique is usually adequate for developing such data. This is true even though we cannot always be sure of exactly why an element varies with a certain physical characteristic of the part.

The main weakness of such data, and this is generally true of most time study data, is that its application is limited. In our examples of making flys, serging, and pressing, there are no elements which can be interchangeable. This means that a separate set of data must be developed for each operation. In attempting to use in one set of data the time for an element developed in another set of data, we often notice a peculiar circumstance. We may notice that the two elements are identical except for one small but important part of the element, and this difference is enough to prevent the elements from being interchangeable. We try to make our elements shorter to make them more interchangeable. In doing this we encounter two other troubles. One is the difficulty of timing very short elements to get a reliable value, and the other is in writing a complete job description of the short element.

After a few experiences of this kind we try to develop a fourth type of time study data. This data will consist of time values for performing very short interchangeable elements. We try to have better possibilities of interchanging elements from job to job. Such a list might include:

Stitch up to 6 stitches to hold.
Stitch seam (calculated by stitches per inch, machine speed, and length of stitch).
Backstitch.
Turn corner on pocket restitch.
Clip thread and dispose forward.
Get part from bench to needle.
Get part to table.
Use both hands, get part to folder.
Move fly tack to tack.
Position next buttonhole, etc.

APPLICATION V

In this fourth type of data we have made a basic change, Instead of basing the application on a physical characteristic of the part, we are now attempting to apply our elements on the basis of the methods used. By making our elements shorter and more basic, we can interchange them from job to job to fit the method used rather than the part handled. Obviously this makes our data more widely applicable from job to job, and we are not limited to similar operations on similar parts as we were with data based on physical characteristics of the part.

For example, a simple operation might consist of:

Get part from bench to needle.
Backstitch.
Stitch 12" seam.
Clip thread and dispose forward.

We could take the values from our list of elements and have a good approximation of what the rate should be. How we use this information would depend upon the confidence we have in our data. For the sewing room, this type of data would be the most valuable type if we could develop a reliable set. It would be widely applicable, easy to apply, and would supply all the advantages we hope for in a set of standard data.

Unfortunately, this fourth type of data, set with time study, has one general weakness. It is limited by the shortcomings of time study and, in this instance, these difficulties might be summarized in five items:

1. It is difficult to find and observe the exact variation of method we want to time.

2. Even when observed, such short elements are difficult to time, especially with a watch.

3. It requires considerable time to develop such data complete enough to be useful in setting rates.

4. It is next to impossible to describe the methods used in sufficient detail.

5. It is difficult to classify the elements for convenient use.

Let us hasten to add that even with its shortcomings, this type of data can be developed and used, and it has been used with good results. I recall in one instance many years ago we used data similar to this to estimate direct labor cost on an entirely different garment than we had been making. We set up the plant and started production. Our final direct labor cost was only 2% different from our original estimate, and this was all done with time study. But it wasn't easy. Today there is a much better way.

Let us summarize the discussion up to this point.

We made some preliminary remarks about the MTM technique to the effect that:

1. MTM is a new tool in the kit of tools used by the Industrial Engineer. It is not magic, but requires hard work to apply it for best results.

2. We said the technique has 3 characteristics which make it useful:

   (a) It requires thorough analysis of the operation studied.

   (b) It provides the means for good job description.

   (c) It provides accepted time values for the basic motions analyzed.

Then we discussed standard data and pointed out some advantages of such data. Those mentioned were:

1. More consistent rates.

2. Rates set more rapidly.

3. Rates set in advance of production.

We then mentioned that standard data can be set with time study and we discussed briefly four types of time study standard data.

Three of these types are applied by use of some physical characteristic of the part handled. These include:

1. The standard operation, as "change bobbin."

2. Complete rates on groups of parts classified by styles.

3. Usual time study data including both constant and variable elements.

The greatest weakness of these types of data is that the application is limited to a group of operations on similar parts. Most sewing rooms have such a small number of similar parts that we might as well set separate rates as attempt to use such data.

The fourth type of time study data consists of a fine breakdown of elements classified by methods

used. This type of data is not common. It is very difficult to develop with time study but is the best type for use in the sewing room and also in some areas of hard goods manufacturing.

Our discussion on time study data has been given for the purpose of pointing out:

1. The types and limitations of sewing data which can be developed with time study.

2. The most useful type of sewing data is very difficult to develop with time study.

Now let us look at one type of data which can be developed using MTM. We want to discuss briefly how this data is developed, but first let us examine the nature of this data.

Since we are going to use MTM to develop our data, we will expect to realize the advantages offered by the use of this technique. We have already pointed out that the most useful type of sewing data would be the type in which the variables are based on method rather than physical characteristics of the part. To develop this type of data successfully we will need to meet at least five requirements:

1. Break down the operation into very short elements.

2. Determine the time value for these short elements.

3. Describe in detail the method used in each element.

4. Classify our elements for easy application.

5. Develop our data within a reasonable time.

We recognize that these are the difficulties which prevented the use of time study to develop such data. It so happens that the first three of these requirements are in the areas in which the MTM technique can be used to best advantage. Thus with MTM we will be able to:

1. Use short elements.

2. Get reliable time values for short elements.

3. Describe elements accurately and in detail.

The last two requirements can also be met with MTM. We will be able to classify our elements, and we can develop the data in a reasonable time.

What do we need to develop this data, and what are the usual steps in its development? In order to start our data, we will need to:

1. Be able to make MTM analyses.

2. Have the determination to do the job.

Having these two pre-requisites, we can start to work.

The first step toward developing our data would be to make MTM analyses of the type of work we want the data to cover. This should include complete analyses of typical jobs, perhaps as performed by two or more operators. As we proceed with these analyses, we will begin to notice short elements which appear in job after job. These elements will form some of the basic elements in our set of data, and will probably include "get part," "position at needle," "raise or lower presser foot," "prestitch" and others.

Some of the decisions we will need to make when selecting and developing the elements for our data will be to decide:

1. Location of the break points between elements. Here is where we can use one of the most important advantages of MTM. If the element is not divided properly when we make the study, it can easily be changed. This cannot be done with time study unless we redo this study.

2. Whether to leave basic elements separate, or combine them for application. We will probably not want to combine them until we have had some experience with applying the data.

3. Size of the steps to use between points in our variable elements. This decision will depend upon the per cent of accuracy we wish to maintain.

4. Whether to make an element a variable or a constant. This will also depend on per cent accuracy as well as convenience in application.

How easy these decisions will be depend to a great extent on how good are our present methods and how much our present methods have been standardized. As we make our analyses, we will invariably see place after place where operators could use better methods in handling their work. These will include shorter reaches and moves, less involved graphs, easier dispose, less repositioning, and many others. We must decide which methods we are going to consider as "standard" and use these methods in our data. The elements included in our data will be only the necessary elements performed in a reasonably good manner. We will find, I believe, that

the better the methods we observe, the easier the analysis and development of data. This will also be true for the application of the data.

So as we make our analyses, and as we consider the elements to be used in our data, we cannot escape thinking about methods. To help guide our thinking on methods, we have prepared a set of questions which we hope will help us discover ways of developing better methods. This list is "I - Guide Questions for Improving Sewing Operations."

We use the questions like this:

1. Analyze the job.
2. Read each question thoughtfully.
3. Direct each question toward the job we have just studied.
4. Try to answer each question and let it lead us to finding a way to improve that job and similar jobs.

This list can be used at any time we want to consider changes in methods.

As we continue our studies, we will discover that the list of basic elements required will be a surprisingly short list. Probably about 10 or 12 classifications will cover all the basic elements we need. These elements will include:

"Get material"	"Sew"
"Position"	"Stop to align"
"Fold"	"Reposition"
"Tack"	"Clip"

In classifying our elements, we always ask the questions, "Why is this element necessary?" "What is to be accomplished by performance of this element?" The answer should be given in terms of one of our classifications. Thus if the answer is, "To get material to sew," then the element is a "Get" element.

Each classification will include different methods of accomplishing the purpose of the element. These various methods will constitute our variables for that element. Where Reach and Move are involved, distance may also be a variable.

To identify each element, we assign a symbol to each type of element, such as GE for get, MT for machine time, DS for dispose, etc. We try to get initials, or some other obvious symbol, which will be easy to remember. Different methods within a classification may be indicated by arabic numerals, as GE-1, GE-2, DS-1, etc.

Eventually we should have a list of elements which we think will cover the work we want our data to cover. Then we try it out. We observe a job. We list all the data elements which cover that work. We note operations or elements we have missed or still need in order to complete the data. We may need to make further analyses on parts of jobs to finally complete our data.

When it is complete, we make studies using our data and then check totals with time study to check our data. When we are satisfied with the data, we are ready to start setting rates with it.

In the event our company makes a variety of styles of different size ranges, we may wish to develop complete standards with size as a variable. With our data we will have complete flexibility for either single rates or set of rates.

In the material passed out to you are copies of two forms used for data and rate development. In the exhibit on Pages 40 and 41, you will note spaces for element description, file number or symbol in upper right corner, and type of equipment. Note also space for "application of element" in which is written instructions for using that particular element. This is important as a record of how you expect the element to be used. It is remarkable how quickly you can forget just how you expected to use the element.

The second form, shown on Page 43, is for use in developing rates, and is largely self-explanatory. To use this form you observe the job, write down the symbols for the elements to be used, write a word or two of description, enter the elemental values, find the total, and apply allowances.

We have not discussed allowances and other phases of rate development such as time reporting, pay plans, etc. These are all a part of the problem of applying rates, especially if you are revising your entire rate structure, but these subjects are outside the scope of this discussion.

After we begin to apply our new rates we will still have problems. Some operators will have to be trained to use new methods. We will have to investigate conditions at the job to determine why results are not what we expect. The second set of guide question, "II - Guide Questions for Improving Application of Rates on Sewing Operations!' are to help us determine where such difficulties lie. When these questions can all be answered "Yes," the chances are that we will have a smooth-running operation. Troubles in rate application <u>usually</u> occur because of failure in some area other than the rate itself. These questions should help us locate the trouble.

Now let us summarize briefly the characteristics of our new data:

1. After a little practice we will find the data can be applied very rapidly. By the time we are ready to apply it, we will have the data memorized, and we will probably continue to revise and develop the data after we start to use it.

2. Rates will include complete methods description and this will help spot changes in method, help in operator training, help change rates because of changes in method, and help develop better methods.

3. We will recognize and indicate the reasons for differences between rates by the elements we select. This will make for consistent rates.

4. Elements in the data will be applied on basis of methods used and can be applied regardless of item handled. This will make the data applicable to most of the work in the sewing room.

5. Reasons for operator failure to meet the rate will be more readily apparent.

6. We will be able to apply our data to work areas other than rate setting. Improving methods has been discussed. Cost estimating will be discussed. Other areas will include new operator training - training to reduce make-up, balance operations on a line - setting up new arrangements of equipment - and any other place where method and performance time will help us make a decision.

In summary - for the development of standard data, time study seems adequate when:

1. The data covers a limited number of similar operations on similar parts.

2. When the variables are based on physical characteristics of the parts.

Many hardgoods shops will have similar operations on similar parts, and here time study works well. In the sewing room we usually have many unlike operations on only a few items or styles, and such data is not widely applicable.

When we want to set simple data on a wide variety of operations, we must base the variables on method. For this type of standard data, in both hardgoods and sewing, we have found MTM to be indespensible.

A. T. KEARNEY & COMPANY - CHICAGO

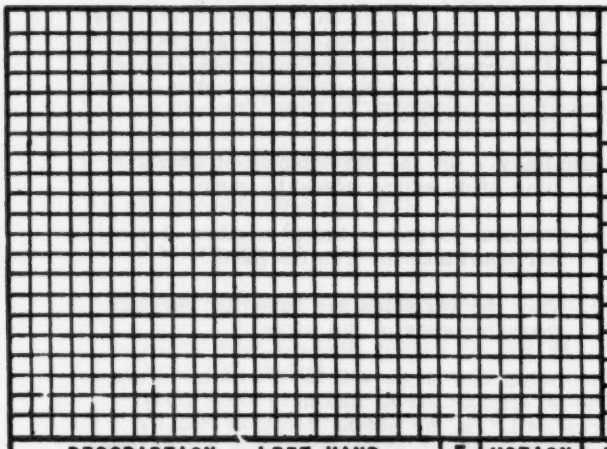
MTM STANDARD ELEMENT FILE GE-5

ELEMENT DESCRIPTION Get part(s) in each hand from machine table or extension

DATE 10-5-56

ANALYST

MATERIALS, TOOLS, EQUIP. ETC. W & G flatlock



DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT Use for parts stacked under arm of flatlock on machine table or extension board

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Reach to material		R8C	11.5	R8C		Reach to material
			3.5	G1B		Grasp close to edge
Grasp material		G1B	3.5			
Re-grasp for good grip		G2	5.6	G2		
Turn to left to separate		T90S	5.4	T90S		Turn to right
Move to machine to match		M10C	13.5	M8C		Move to separate and to
with part in rt. hand		~~G2~~	-	~~G2~~		arm of machine to match
Total TMU			43.0			

A. T. KEARNEY & COMPANY - CHICAGO

MTM STANDARD ELEMENT FILE DS-1

ELEMENT DESCRIPTION Toss end of garment toward rear or left of machine table-one or both hands

DATE 10-5-56

ANALYST EJS

MATERIALS, TOOLS, EQUIP. ETC.

DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT

Use in any case where grasp for rough dispose can be completed during machine cycle and where careful stacking is not required

Hand(s) grasp garment at leading edge for dispose. See element #DS-2 when end of garment is flipped onto stack

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Toss end of part over stack		M-B	-	M-B		On automatic machines where grasp may be completed during MT, two hands may be used, other machines use one hand
Release toward stack		~~RLT~~	-	~~RL1~~		
Return hand toward work area (one-half move dist.)		R-E	-	R-E		

Inches Move	6	8	10		12	14	16		18	20	24
TMU M-B	8.9	10.6	12	2	13.4	14.6	15.8		17.0	18.2	20.6
TMU R-E	5.3	6.8	7	4	8.0	8.7	9.3		9.9	10.5	11.8
Total TMU	14.2	17.4	19	6	21.4	23.3	25.1		26.9	28.7	32.4

A. T. KEARNEY & COMPANY - CHICAGO

METHODS ANALYSIS AND STANDARDS SHEET

SKETCH OR REMARKS

Date 10-5-56 Operation No.

Operation Name Close Crotch
Garment Boy's Underwear Brief
Style Regular Size Medium
Materials Light Cotton Knit
Machine Class W & G Flatlock
RPM 2800 SPI 14
Inches of Stitching 9
Feed Dog
Throat Plate
Foot
Threads 9
Needles 4
Bobbins
Attachments

Element Description and Training Comments	Time in TMU		Element Description and Training Comments	Time in TMU	
			Carried Forward from Left		
GE-5 Get Material	43	0	←		
GE-6 Assist Get	21	7			
P-1-Close Place to Foot	32	9			
TA-1 Lower Foot	8	5			
S-1-4 Stop and Align	13	6			
MT-1 Sew	102	1			
CT-1 Cut Thread	10	9			
DS-1-24 Toss End	32	4	←		
B.T. Bundle and Ticket	15	6			
Total TMU Per Garment	280	7			
Sub-Total					

Total TMU Per Operation	280.7
No. of Opns. Per Unit 24 Garments Per Unit 24	
Total TMU Per Unit	
Conversion Factor Including 17½ % Pfd. Allowance	.01692
Standard Minutes Allowed Per Unit of 24 Garments	4.75
Analyst: EJS Approved: RCR	

APPLICATION V

HOW TO USE THESE GUIDE QUESTIONS

Following a list of guide questions is an easy and an effective technique to use in finding better ways of performing an operation. To use this technique we first learn all we can about the present method. Second, we answer thoughtfully each question on our list in an effort to discover improvement possibilities. Answering such a list of questions helps us think about the usual ways of improving a job. More questions can be added to the list as we use it.

Two sets of questions are attached to this page.

The first list can be used for improving individual operations, and may be used while developing standard data, when setting rates with the data, or when trying to improve an operation at any time.

The successful application of production standards requires attention to many details other than just setting the standards. The second set of questions can be used to discover other areas which may require attention in order to make the standards "work" better.

I - GUIDE QUESTIONS FOR IMPROVING SEWING OPERATIONS

I-A GETTING THE WORK TO THE NEEDLE.

Is the work placed so the operator can grasp at the point of the first stitch?

Is the work folded properly at the previous operation?

If more than one piece is handled, are both hands used simultaneously in getting them?

Is the work obtained from the closest possible point?

I-B SEWING

Exactly why is each part of this operation done?

Will this operation add value to the finished product?

Can any part of the operation be eliminated?

Is the quality too high? Too low? Exactly what can be done to get proper quality?

Can some of the operation be done at a different location?

Can the sequence of operations be changed?

What other operations require the same combination of thread colors? Can a bobbin thread color be changed?

Will a guide, gauge or folder assist the operator to reduce position time, eliminate a stop, or do a better job?

Is the machine being used the best one for the job? Can a chain stitch be used instead of a lock stitch?

Can the number of times the material is handled be reduced?

Can the stitching be started from the opposite end of the seam or opposite side of the material?

Can the layout be changed in any way to reduce strain or fatigue?

I-C DISPOSING THE WORK

Before disposing, is it possible to perform any other operation of this part?

Can the next part be started before breaking thread?

Is the part or garment disposed the shortest possible distance?

Is it disposed in best form for the next operation?

Can folding be eliminated?

Can the folding be limited out by machine time?

II - GUIDE QUESTIONS FOR IMPROVING APPLICATION OF RATES ON SEWING OPERATIONS

II-A EQUIPMENT AND LAYOUT

Are all machines running at correct speed?

Are rubber belts used on all suitable machines?

Is the correct number of stitches per inch used on each operation?

Are bobbin winders adjusted to get maximum thread yardage on each bobbin?

Has machine layout been reviewed, and are required revisions complete?

Are production aids such as table extensions, chutes, guides and folders in operation?

Is a definite location provided for work between operations?

Are bundles of work stored between operations so that no time is lost in matching bundles of parts?

Is proper general and machine lighting being used?

Is each work-place adjusted to the operator?

Are all operators on same job using identical equipment?

II-B OPERATOR

Is operator following correct method for the job?

Is she spending full required time on the job?

Does the operator fully understand her part in reporting her time and production? Does she follow these instructions?

II-C MANAGEMENT AND SUPERVISION

Are operators always supplied with new work promptly when needed? Is finished work removed promptly?

Are procedures developed, and being used, for handling operator's time in case of delay for any cause?

Do all supervisors understand policies and use correct procedures for recording of time and payment for delays, daywork, and transfers?

Are supervisors able to answer operator's usual questions about the incentive plan, and alert to get advice on unusual questions?

Have the quality requirements been defined for each operation, and are these quality standards applied?

Are procedures developed for handling repairs?

Are repairs handled promptly?

Are supervisors (and operators) informed daily of of operator performance? Are supervisors alert to correct sub-standard performance?

Is provision made for methods work to continue and for rates to be kept up to date? Are accepted methods changes reflected in current rates?

MTM'S CONTRIBUTION TO ESTABLISHING AND BALANCING ASSEMBLY LINES

by
J. F. Radford
Florence Stove Company

ORGANIZATION OF A METHODS PROGRAM AND RESULTS OBTAINED

First, I wish to express my pleasure at being here and in having the opportunity to relate to you what MTM and the Florence Production Team has done.

My subject is intended to provide information on ways and means of selling our programs to others. It is essential, therefore, to give something on the background leading up to this subject so that those of you who may have similar problems can direct the obvious parallels.

Our company is the Florence Stove Company--one of the oldest names in the cooking and heating business with the main plant in Kankakee, Illinois. This program was developed at Kankakee where we manufacture Kenmore ranges for for Sears and Roebuck.

We presently employ approximately 1,200 people utilizing over one-half million square feet of manufacturing area with typical production departments such as a final assembly, paint and enameling facilities, and a large press and welding department with over 300 pieces of equipment of varying types and sizes.

The plant capabilities of the Mounting Room (as the final assembly department is called in the stove business) is approximately 1,000 stoves per day on a one-shift operation.

The unions involved are all A. F. of L. and there are six!

Four years ago the executive officers of our company faced the problem of mounting operating costs with considerable concern. The long-term future of the corporation was in danger.

At that time it was decided that we should develop an ideal department which would contain all of the service organizations, that is, Methods Engineering, Time Study, Tool Engineering, Tool Room, Maintenance, and Power-Steam services. Previously, all such functions had been divided under the Plant Superintendent with very little correlation of activity.

In September of 1953, the Industrial Engineering Department was created--combining all previous service functions into one production engineering group under a Chief Industrial Engineer. Because of the acute situation then prevalent, a new Standards/Methods Department was organized and a master operating plan developed.

Our organization is now composed of a Tool Engineer, who is responsible for all tooling, tools, and equipment maintenance and procurement/ the Plant Engineer, having responsibility for plant and property maintenance and other services such as power house compressors, etc./ a Chief Standards/Methods Engineer whose people are responsible for processing, methods and standards.

Now, as to the specific program mentioned previously--Once the Standards/Methods Department was created--we had to take a cold, hard look at our complete operation--piece rates (This is an incentive shop), methods, equipment, layout, and material handling activities.

We had to sell our unions (All six) and our supervision on a complete review of our methods and piece rates.

The following points are always present in a failing incentive system and, unfortunately, all seven were prevalent in the piece rate plan then in operation:

1. Lack of an established methods program.
2. Lack of standardization of methods.
3. Lack of follow-up by those charged with administration.
4. Improper concept of a system.
5. Lack of good administration and maintenance.
6. Wrong attitudes on the part of management personnel.
7. Poor control of materials and schedules.

One of these master plan points was the evolution of a system of standard data. Since it was certain that insufficient time was available to establish our own time study data--predetermined time systems currently available in the consulting market were investigated with the ultimate

selection of MTM. A management consulting company worked out a program and during November of 1953 we started our combined 105 hour training program with their personnel as instructors. Included in the preliminary program were union personnel and all Standards/Methods people then available. Towards the middle of this program, a 16 hour appreciation course was organized including again union people, supervision and other management personnel.

Now, as to the specific results of the program --as started in September of 1953 when the Industrial Engineering Department was created:

> Savings of over $350,000 were realized in the first year after the start of this organized cost reduction program.
>
> Our employment increased from 868 people to 957 in spite of a reduction of some 50 people from the final assembly department. (This was possible because we provided our customer with better prices as the result of the program.)
>
> Where at previous similar production levels we would have operated the assembly department in two (2) shifts, we now operate and produce the same number of ranges in one (1) shift.

I would like to talk to you about our assembly line techniques at Florence and the indispensible part MTM plays in these techniques.

Our data give accurate time values with a consistant performance level plant-wide. It is not subject to opinion of pace. Our system forces method analysis of every job for which a standard is set. The object of this case study is to develop a procedure for balancing an assembly line for our product. Because of mechanical problems, as with most products, it is necessary to assemble the component parts in a specified sequence or sequence grouping.

See Exhibit "A" - "Frame Components"

On the other hand, certain components may be assembled without regard to sequence.

See Exhibit "B" - "Flue Box"

And certain components because of the relationship to other parts may be more economically assembled "off the line."

See Exhibit "C" - "Manifold"

This mass production assembly technique has many important advantages, namely:

1. Cuts down training time.
2. Task specialization.
3. Efficient use of equipment.
4. Minimizes handling.
5. Reduces in-process inventory, etc.

However, it does pose many extremely difficult problems. Each workman must be assigned a task which is equal to or less than the sum of total line time divided by the number of line stations or station balance.

The ideal station balance provides no high cycle station. All must be equal. In our product this is impossible. How, realizing that the high or bottleneck station (which limits other stations from working) will limit production--it is essential to maintain as close a balance as possible to protect assembly costs.

This, of course, is feasible--however, let's consider our product and scheduling problems. We currently have 79 models of free standing ranges, approximately 300 active built-in ovens and surface units in our complete line.

During the month of October we have scheduled 32 different models in free standing ranges in production quantities from 10 to 1,000 per day, to a total of 22,000 ranges in our four-week period. Currently this balancing problem is being handled by four men--two on assembly and two on sub-assembly.

All production is run over (2) main lines and one short line and several bench lines for certain counter-top units. Each line may be set up for a different production rate. This determines the number of operators and the breakdown of the operations. In any case, a free standing range is processed for total time as if it were to be run over the main lines. This establishes the total work time as determined by standard data.

Let us then describe a card technique used at Florence. First, we do not have an IBM system, therefore, it was necessary to develop this around a McBee punch card.

See Exhibit "D" - "Coded Card"

USE OF CODED CARDS IN LINE BALANCE

Step 1 Product Engineering supplies the Standards/Methods Department with the basic model to be made on the line and a bill of material.

Step 2 The basic model is dis-assembled in the Standards/Methods Laboratory.

Step 3 The basic model is broken up into small elements which are analyzed after the best way to assemble the stove has been found.

Step 4 These elements are analyzed using MTM to determine the time value. Every motion used to perform each element is recorded and the MTM value card is used to give each motion a value in TMU's.

Step 5 The total TMU's are added for each element which is changed to decimal minutes.

Step 6 We have tried to break the stove down into major parts which we call "Major Elements." We have, to this date, with our present models, six (6) Major Elements. 1 - Framing, 2 - Cutting, 3 - Testing, 4 - Finishing, 5 - Packing and 6 - Crating. These are the six (6) major processing steps necessary to assemble a stove. (Exhibit "E" - Reference Code).

Step 7 Each Major Element is broken up into sub-major elements, i.e. 3-1 (Test gas) or 3-2 (Test electric). The sub-major elements vary from model to model so that one 30" model may be exactly like another except for feature revisions.

Step 8 Under each sub-major element falls the elements.

Each element has the basic motions n needed to be performed. (It is a must that the engineer analyze the operational motion to consider the best method pattern.)

It is extremely important to get the basic model laid out as perfectly as possible because all future step-up models are laid out accordingly with feature revisions.

Step 9 The 1st phase of a 30" model is Framing #8. You will note that we have many sub-major elements under framing but Framing #8 is used only on 30" models.

All the elements in Framing #8 are used until there is a definite break in the operation such as turning the stove on its head, that would be the end of Framing #8.

Step 10 Framing #9 would follow until there is a definite break in the operation as turning the stove on its base.

Step 11 After all elements are used pertaining to Framing #9, Framing #10 follows until this phase is complete.

There are elements in the sub-major elements #10 and #9 which could be used before a sub-major element #8 but are held out and used only when the balance time of a station is smaller than the high station. This keeps a line balance more even.

Step 12 After the framing of a stove is complete, the next phase in assembly pertains to gutting; gutting is broken up into 3 sub-major elements, gas, electric, and flue deflector.

Step 13 Next step is to gas test the stove which is Major Element #3 and sub-major element #1.

Step 14 Electrical testing is performed at this time and is under Major Element #3 sub-major #2.

Step 15 The stove is ready for finishing parts to be assembled.

Step 16 The design of the stove is such that the oven door #3 is the first sub-major element under Major Element #4 Finish.

The finish major elements are not necessarily in order in which they are assembled on the line. Many of the finish elements can be done in different sequence for line balance on different models. For this reason, we are able to pull small elements from these sub-major elements to be able to fill a light station.

Step 17 After all enameled parts are assembled the line-up of doors and/or pull out drawers is completed.

Step 18 At this point pack and crate or carton is complete.

It was necessary to go completely through a basic model step by step to show how the code follows the line assembly fairly closely but not necessarily in succession.

Although elements are described briefly with cards, the motion patterns to back up the elements are kept on file for reference.

See Exhibit "F" - "MTM Element Analysis"

After models are balanced using the coded cards, the stations with their elements are typed up on individual cards and are used to instruct the assemblers when this model is run on the line. Each station is typed with all the elements on one card.

See Exhibit "G" - "Station Layout"

You will notice the coded punch cards have designated points for major elements, sub-major elements, and sub-elements and time value. This is for sorting purposes.

See Exhibit "D" - "Coded Card"

After a basic range has been analyzed and run on the assembly line and approved, it is accepted as a basic model and future models can be patterned from it, adding and deducting wherever necessary.

There comes a time in the life of many a company when the old reliable blueprints that management has followed so successfully for years no longer do the trick. As someone has said--the traditional way of manufacturing is like an old pair of shoes - comfortable - but you can't wear them forever.

Time study then is like tradition--At Florence we discarded time study and adopted MTM as a basis for standard data. And after this much experience we would find it impossible to do without it.

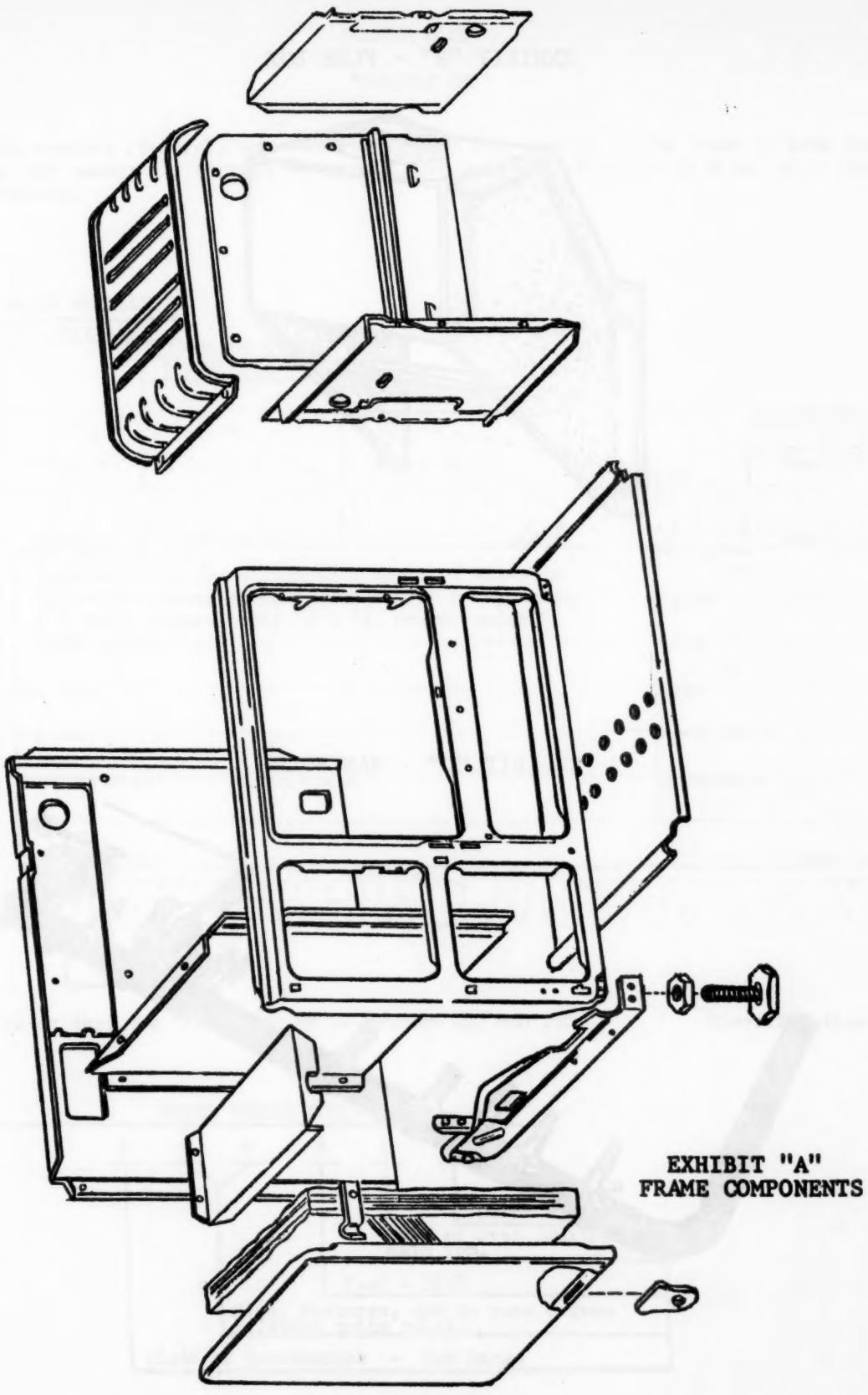


EXHIBIT "A"
FRAME COMPONENTS

EXHIBIT "B" - FLUE BOX

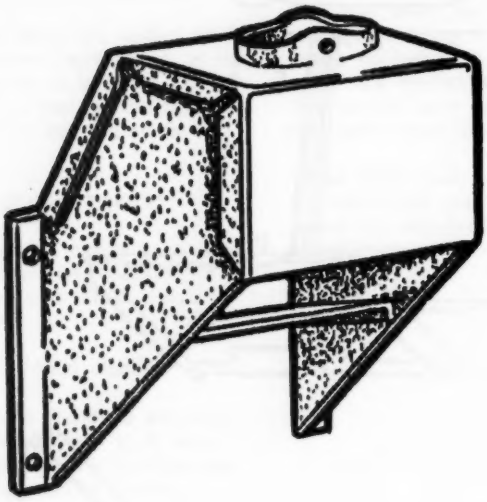
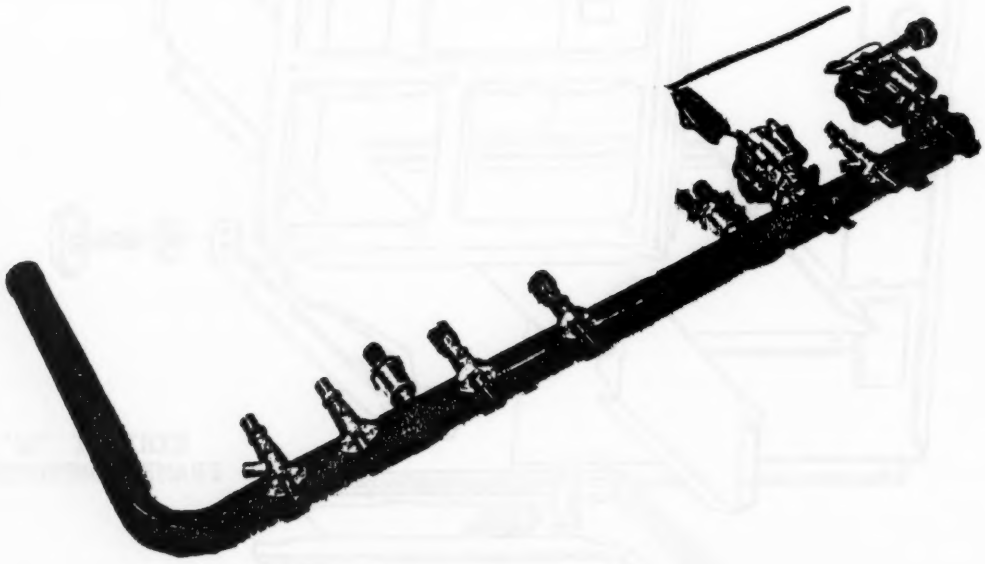


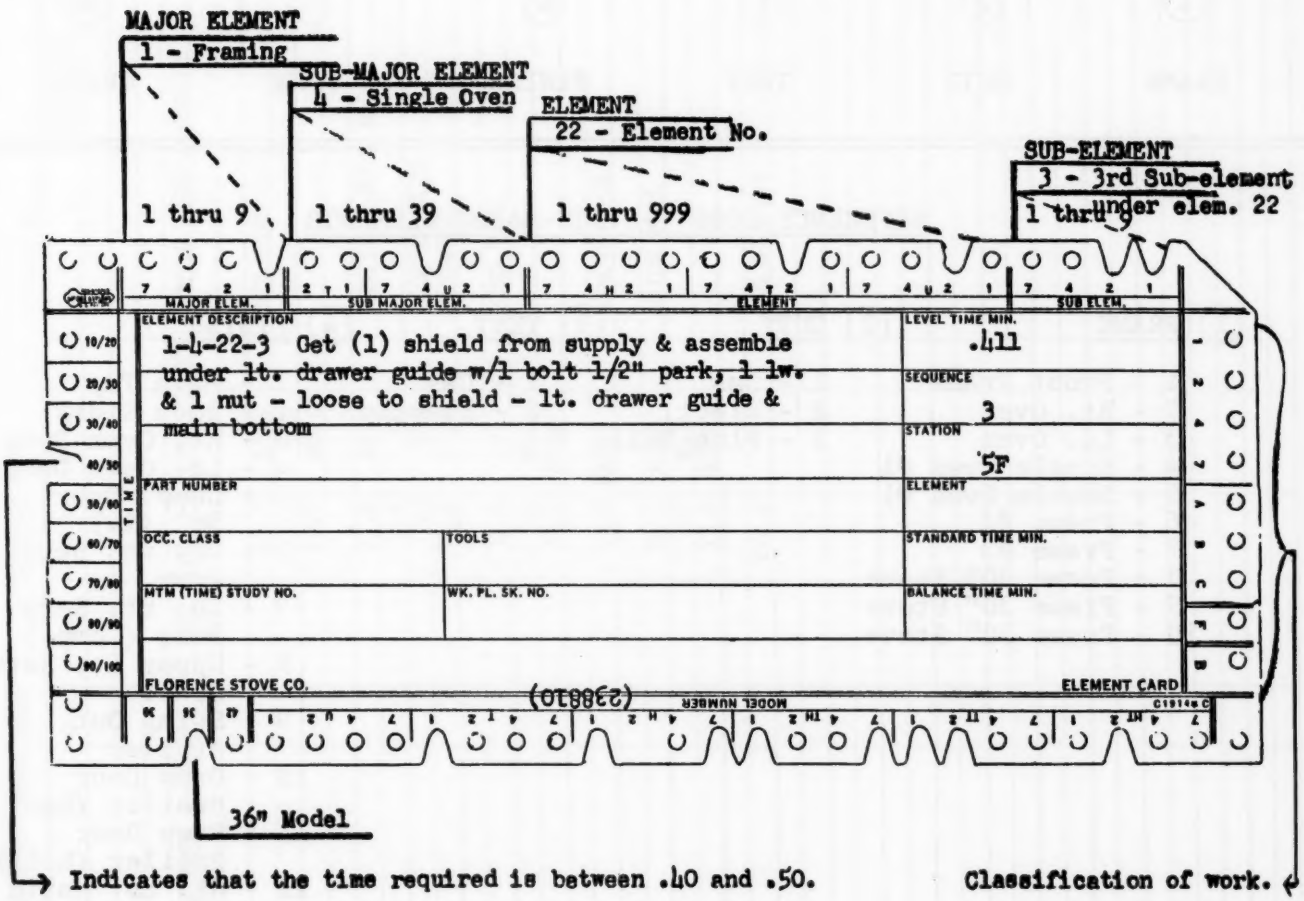
EXHIBIT "C" - MANIFOLD



"CODED CARD"

"EXHIBIT D"

The numbers (7-4-2-1) are used rather than (1) through (9) in order to save space as any number (1) through (9) may be formed by a combination of (2) or (3) of these numbers.



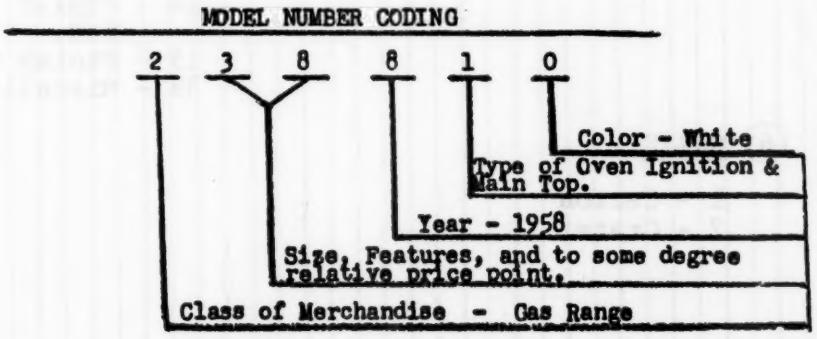

MODEL NUMBER CODING
2 3 8 8 1 0
Color - White
Type of Oven Ignition & Main Top.
Year - 1958
Size, Features, and to some degree relative price point.
Class of Merchandise - Gas Range

EXHIBIT "E" - REFERENCE CODE

REFERENCE CODE - MAJOR ELEMENTS

①	②	③	④	⑤	⑥
FRAME	GUTT	TEST	FINISH	PACK	CRATE

REFERENCE CODE - SUB-MAJOR ELEMENTS

① FRAME

1 - Front Frame
2 - Rt. Oven
3 - Lt. Oven
4 - Single Oven #1
5 - Double Oven #1
6 - Frame #2
7 - Frame #3
8 - Frame 30" Stove
9 - Frame 30" Stove
10 - Frame 30" Stove

② GUTT

1 - Gas
2 - Elect.
3 - Flue Defl.

③ TEST

1 - Gas
2 - Elect.

④ FINISH

1 - Main Top
2 - Body Sides
3 - Rt. Oven Door
4 - Lt. Oven Door
5 - Comp. Door 36" (lo)
6 - Lo. rt. Serv. Drwr.
7 - Lo. rt. Serv. Door (Comp.)
8 - Upper Lt. Serv. Drwr.
9 - Swing Out Broiler
10 - Drop Door Broiler (Rod)
11 - Drop Door Broiler (Roll)
12 - Hi. Lo. Matic - Lt. Oven
13 - Finish - Line up
14 - Finish Lt. Oven Std.
15 - Finish Rt. Oven
39 - Miscellaneous

⑤ PACK

1 - Tape
2 - Pack

⑥ CRATE

1 - Carton
2 - Crate

FLORENCE STOVE COMPANY - M. T. M. ELEMENT ANALYSIS EXHIBIT "F"

PART NO._____ OPER. NO._____

DESCRIPTION - LEFT HAND	OCC.	MOTION	T.M.U.	MOTION	OCC.	DESCRIPTION - RIGHT HAND
ELEMENT NUMBER 2-1-41-1		- GET TOOL - ASIDE TOOL		STRAIGHTEN		LIGHTER TUBE ASSEMBLY
			21.5	R2AB		GET TOOL
			3.5	61B		
			20.6	M2AB		
			17.0	M18B		POSITION TOOL TO
			5.6	G2		
			7.3	M4C		LIGHTER TUBE
			11.2	P1SD		ASSEMBLY
			32.4	AP1	2	BEND TUBE
			3.4	M1C	2	
			11.2	P2SE		
			17.0	M1813		REMOVE TOOL
			24.3	M30B		ASIDE TOOL
			1.7	RL1		
			15.5	R18E		
			192.2			115 MINUTES

ELEMENT # 2-1-41-1

STUDY NO._____

SHEET_____

OF_____SHEETS

K 29

53

APPLICATION VI

CARD SAMPLE SENT TO ASSEMBLY DEPARTMENT

EXHIBIT "G"

Model 202600		Station 1F
1	1-8-1 Land 1 base carton cap from load to conveyor w/wide part to back 71346	.176
2	1-8-2 Land oven lining assembly to cap w/back up and bottom facing back 70899	.131
3	1-8-3 Land 1 pc. insulation to oven back lining and adjust ready to trim (1 x 20 x 26-1/4 70508	.188
4	1-8-4 Notch insulation for retainer with knife, dispose of knife and scrap insulation	.226
5	1-8-6 Get main bottom to stove w/drawer guide holes to frt., flanges down, set aside bad part if nec. 70444	.210
		.931

Model 202600		Station 3B
1	1-8-10 Get main back w/insulation retainer and check welds and for defects and land, set aside bad part if nec. 70632	.221
2	1-8-11 Position main back to stove	.037
3	1-8-12-1 Get and assemble (2) #10A x 1/2 ph. tr. hd. park. self tapping screws and 2 flat speed nuts #10A to main back and lining, tight 70722 69366	.359
4	1-8-14 Turn stove upside down, front facing front of conveyor	.070
5	1-8-13 Place spring clamp to hold main back at bottom	.054
6	1-9-5 Get 2 base side panels, land and check set aside bad part if necessary.	.192
		.933

(Actual part of layout used on 30" range)

APPLICATION VI

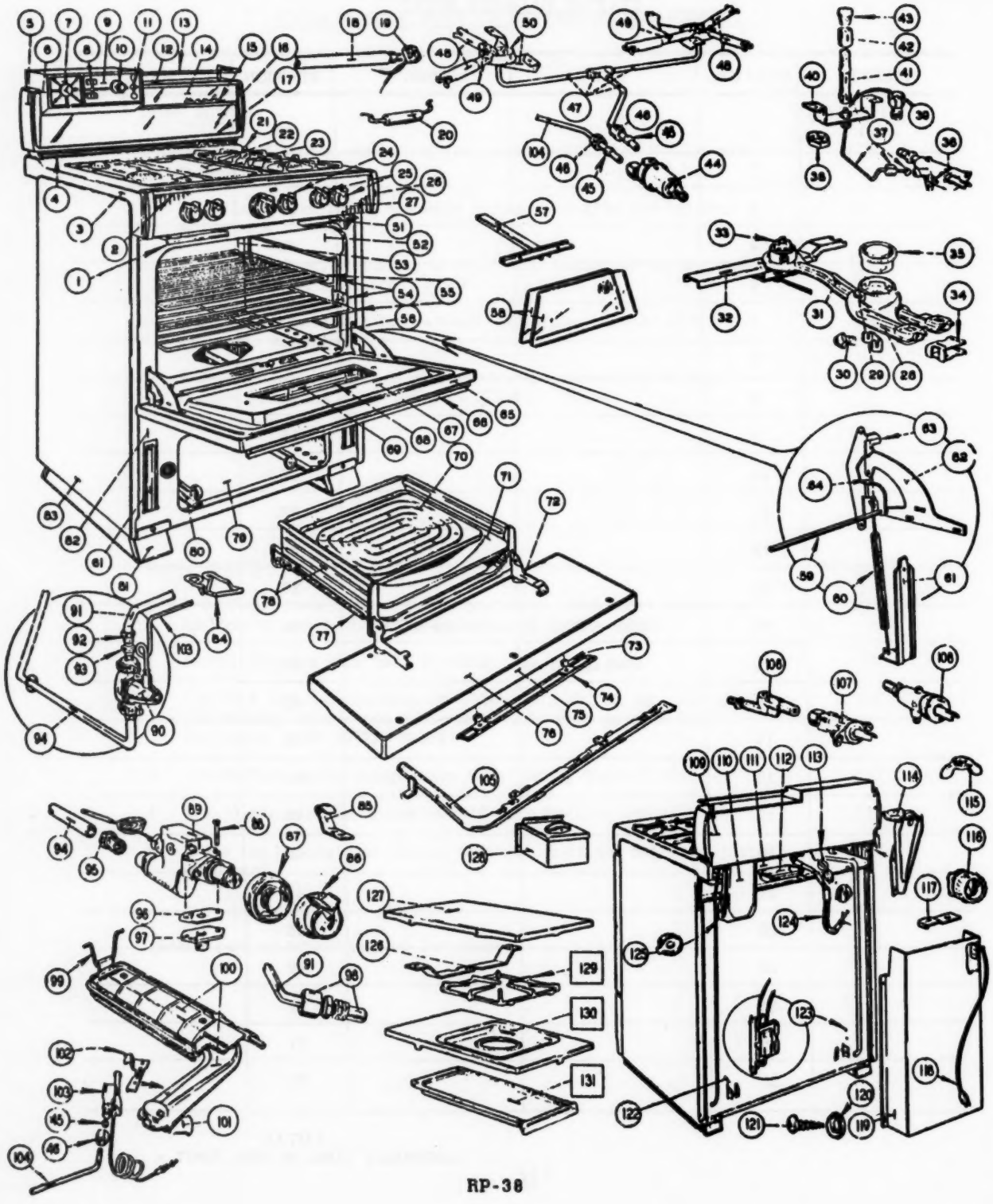
STATION BALANCE SHEET

FRONT	STATION	BACK	FRONT	STATION	BACK
.931	1			27	
	2			28	
	3	.933		29	
	4			30	
	5			31	
	6			32	
	7			33	
	8			34	
	9			35	
	10			36	
	11			37	
	12			38	
	13			39	
	14	(See station layout cards for		40	
	15	stations #1-#3)		41	
	16			42	
	17			43	
	18			44	
	19			45	
	20			46	
	21			47	
	22			48	
	23			49	
	24			50	
	25			51	
	26			52	

TOTAL
ASSEMBLY TIME IN MIN./UNIT =

ILLUSTRATION FOR KENMORE GAS RANGE

MODEL NUMBER 103.203810



RP-38

ENGINEERED WORK MEASUREMENT

November Publication

by

Delmar W. Karger and Franklin H. Bayha

635 pages, 6 by 9 inches, 120 illustrations, tables, graphs, and official MTM data card insert.

Published by the Industrial Press

New York, N. Y.

The increasing use of work-measurement systems by scientific managements both here and abroad has emphasized the need for a comprehensive text on this important work-study function of industrial engineering.

Engineered Work Measurement is the first really complete up-to-date text on Methods-Time Measurement to appear in a decade. Not only does it provide a thoroughgoing exposition of the principles, data, and techniques of MTM, but also it coordinates this internationally recognized and outstanding predetermined times system with the well-established techniques of time and motion study and shows how these are really interrelated and complementary rather than opposing systems.

Starting with the background and history of work measurement, the book devotes 14 chapters to the fundamentals of MTM. Every term is defined and illustrated and special MTM mathematics, standards, applications, and the organization and development of MTM training courses are covered in detail. A special feature is the chapter on simplified MTM which should be especially valuable for the design engineer, tool engineer, foreman, or anyone who wants to determine exactly which of several work methods is most efficient for performing a given operation.

Several chapters present a thorough survey of time and motion study as used to measure process and cycle, times and the background, uses, and the latest and best in accessory equipment, techniques and time study forms are described and illustrated.

The following titles of the 32 chapters in the book indicate the scope and thoroughness of the book: Origins -- a Brief History of Scientific Management and Work Measurement; Orientation -- Human Factors in Modern Business; Predetermined Time Systems -- Development and Comparison; Methods-Time Measurement -- A New Approach; The Methods-Time Measurement Association for Standards and Research; Basic Concepts and Performance Rating; Reach; Move; Turn; Crank; Apply Pressure; Grasp; Release; Position; Disengage; Eye Motions and Allied Topics; Body, Leg, and Foot Motions; Motion Combinations; Motion Patterns -- Method Evidence; Simplified MTM Data; Fundamentals of Time Study Observations; Analysis Procedures and Techniques; Allowances and Variances -- Adjustment of Standards; Mathematics in Work Measurement; Control of Labor Costs Based on Standards; Fundamentals of Motion Economy; Standard Data and Time Formulas; Application Areas for Work Measurement Techniques; Installing MTM; MTM Training Courses; Organizational Aspects of Work Measurement; Management of Methods and Labor Control.

Since the book covers both MTM and time-and-motion study the reader can judge the distinct areas of application as well as the many situations which demand their combined approach. The practicing engineer will find this book a valuable working reference. The student will find it to be a thorough text that will facilitate his understanding of work measurement as a powerful management tool for determining labor standards and establishing improved manufacturing methods.

- NOW AVAILABLE -

MTM DATA ANALYSIS SHEETS – AS FOLLOWS:

MTMA-1001	Analysis one side	2.00
MTMA-1003	Analysis two sides	2.25
MTMA-1002	Summary Sheets	2.50

(price per pad of 100 sheets)

MATERIALS AVAILABLE

EFFECTIVE DECEMBER 1, 1956

ORDER BLANK

RESEARCH REPORTS	QUANTITY	UNIT PRICE		EXTENSIONS
		Member, Academic, Library	Non-Member	
R.R. 101		$ .75	$10.00	
R.R. 102		.50	10.00	
R.R. 104		.50	10.00	
R.R. 105		2.25	25.00	
R.R. 106		2.25	25.00	
R.R. 107		2.25	25.00	
R.R. 108		2.25	25.00	
Application Training Supplement		2.00		
Proceedings				
1954 MTM Conference		4.00	7.50	
1955 MTM Conference		4.00	7.50	
1956 MTM Conference		5.00	7.50	
Data Cards				
Detailed Paper		(See Table Above)		
Detailed Plastic				
Condensed (Plastic)				
Simplified (Paper)				
Analysis Sheets				
MTMA-1001		2.00		
MTMA-1002		2.50		
MTMA-1003		2.25		

NAME _____ PLEASE SEND BILL_____

POSITION_____ **COMPANY**_____ PAYMENT ENCLOSED_____

ADDRESS _____ Remittance must accompany orders under $5.00.

Send order to: MTM Association for Standards and Research, 216 So. State St., Ann Arbor, Mich.

Please send . . . . . copy (copies) of the

Journal of Methods Time Measurement

☐ Enclosed check in the amount of $. . . . . .

Name . . . . . .

Address . . . . . .

Subscription Rate:

Domestic - U.S. and possessions and Canada - $2.50 per year
Other - $3.50 per year

Make checks payable to the MTM Association, 216 S. State Street, Ann Arbor, Michigan.

RESEARCH REPORTS

R.R. 101 Disengage

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems

A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions

This report represents almost two man-years' work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves

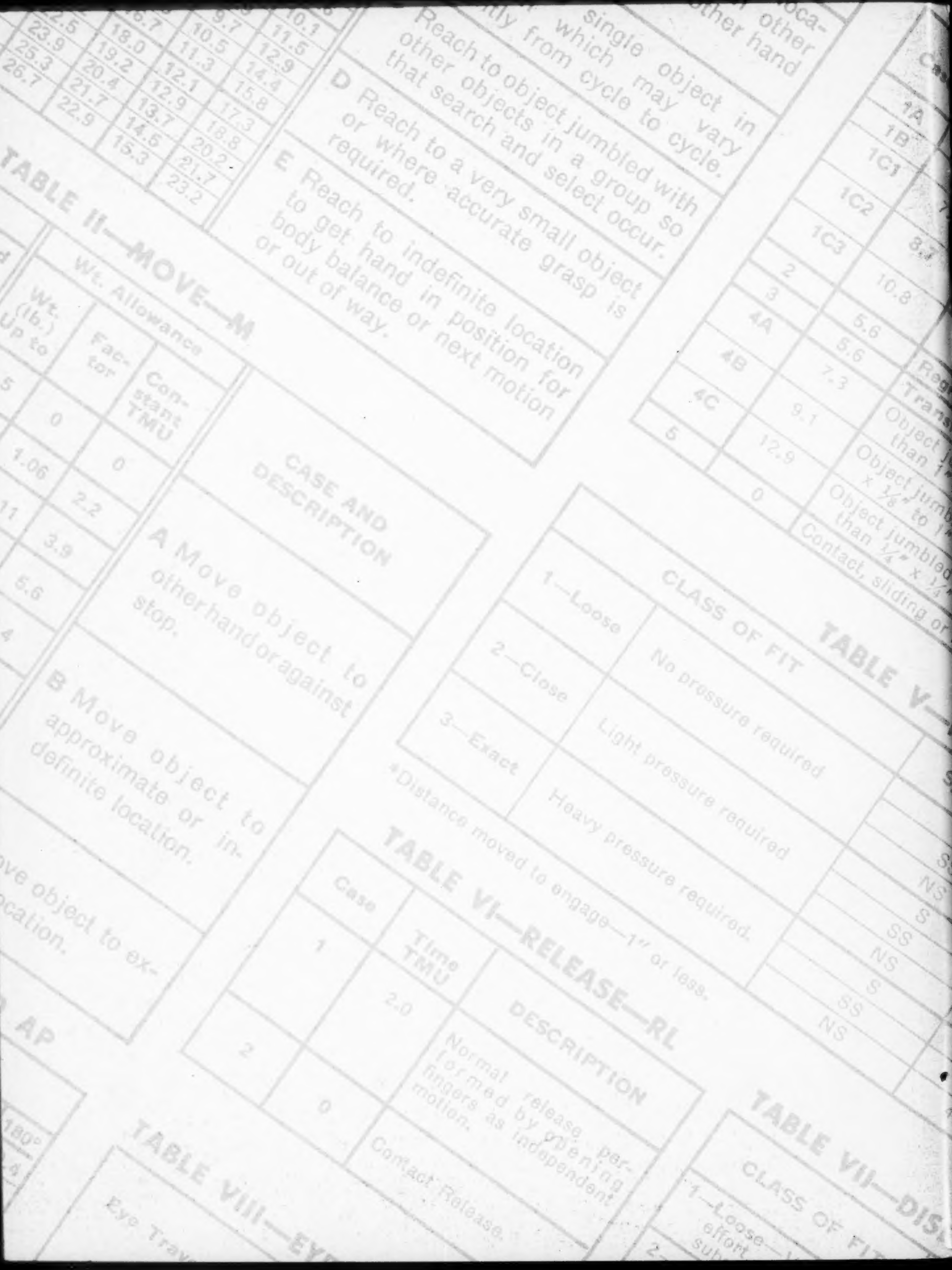
This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual

The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight

In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensive discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.


single object in
which may vary
from cycle to cycle.
Reach to object jumbled with
other objects in a group so
that search and select occur.
D Reach to a very small object
or where accurate grasp is
required.
E Reach to indefinite location
to get hand in position for
body balance or next motion
or out of way.
TABLE II—MOVE—M
Wt. Allowance
Wt. (lb.) Up to
Fac-tor
Con-stant TMU
CASE AND DESCRIPTION
A Move object to otherhandoragainst stop.
B Move object to approximate or in-definite location.
ove object to ex-
cation.
TABLE V—
CLASS OF FIT
1—Loose
No pressure required
2—Close
Light pressure required
3—Exact
Heavy pressure required.
*Distance moved to engage—1" or less.
TABLE VI—RELEASE—RL
Case
Time TMU
DESCRIPTION
Normal release performed by opening fingers as independent motion.
Contact Release.
TABLE VII—DISE
CLASS OF FIT
TABLE VIII—EYE
Eye Trave